Attachment 1

Gantry and Kettle Handling

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December 9, 2016

Ms. Suhasini Patel
Senior Environmental Scientist Supervisor
California Dept. of Toxic Substances Control
8800 Cal Center Drive
Sacramento, CA 95826-3200

RE: Gantry System Implementation
Closure of Exide Facility, Vernon, California

Dear Ms. Patel:

Exide Technologies is in receipt of the California Department of Toxic Substances Control's (DTSC's) November 29, 2016 letter regarding the Gantry System Method of Mechanical Kettle Removal. DTSC's letter summarizes additional information that DTSC has suggested be included in the Phase 1 Closure Implementation Plan (Implementation Plan) if DTSC approves mechanical removal as part of the Closure Plan and Exide selects the gantry system method (Gantry System) as the preferred method to implement mechanical removal.

Exide has also received DTSC's approved Closure Plan for the facility, which is dated December 8, 2016 and indicates that mechanical removal will be used to remove the seven kettles containing hardened lead that are too heavy to be removed with the existing Smelter Building cranes. Exide has selected the Gantry System to implement the mechanical removal.

PHASE 1 CLOSURE IMPLEMENTATION PLAN

As required by Closure Plan Section 4.2.2, Exide will submit the Implementation Plan, which will be prepared by Exide's Closure Contractor, American Integrated Services (AIS), within 30 days of DTSC's December 8, 2016 Closure Plan, or January 9, 2017. The Implementation Plan will address all Phase 1 activities. As required by Closure Plan Section 4.2.2, the Implementation Plan will include the following: scope of work; schedule; sequence; supplemental dust mitigation measures; work hours; procedures, sequence and techniques for work tasks; site-specific Health and Safety Plan; and Demolition Engineering Survey. Please note that as the Closure Plan was just approved and issued yesterday by DTSC, Exide has not had the opportunity to review the Closure Plan in detail nor complete preparation of the Implementation Plan.

However, Exide respectfully requests DTSC's written approval of the Gantry System prior to its submission of the Implementation Plan. The enclosed documents relate to the implementation of the Gantry System, and include implementation methods, air emission controls, engineering evaluations, health and safety, schedule and sequencing. Exide requests written approval of the Gantry System on or before December 27, 2016, after which the technical and other information regarding the Gantry System will be incorporated into the Implementation Plan, but will not be subject to further review or approval.

GANTRY SYSTEM IMPLEMENTATION

The Gantry System applies to seven kettles containing hardened lead which are too heavy to be removed with the existing Smelter Building cranes. The seven kettles will be lifted by the Gantry System and transferred to the Blast Furnace Feed Room. The kettles and hardened lead will then be cut into smaller pieces for transport for recycling. Because of their weight, the seven kettles cannot be kept intact for transport and handling and are not proposed to be sent to an alternate facility for re-use.

The seven kettles are summarized as follows:

- Unit 90 (Receiving Kettle B) (50 tons)
- Unit 91 (Receiving Kettle E) (65 tons)
- Unit 92 (Receiving Kettle F) (100 tons)
- Unit 93 (Receiving Kettle G) (12 tons)
- Unit 96 (Refining Kettle 3) (15 tons)
- Unit 97 (Refining Kettle 4) (30 tons)
- Unit 100 (Refining Kettle 7) (15 tons).

The attached appendices discuss implementation of the Gantry System (some of the documents, such as the description of the HAKI System Design, necessarily relate to the overall Phase 1 closure process, but include information relevant to the process of removing the kettle lead using the Gantry System):

1. Figures
    a. Implementation Plan Figure 2 showing Full Enclosure Unit segments, including Segment 2, which would enclose both the Smelter Building and the Blast Furnace Feed Room
    b. Gantry System plan view
    c. Gantry System cross-section view.
2. Deconstruction Engineering Survey
3. HAKI System Design
4. Air Emission Control calculations
5. Sketch of conflicting building elements
6. American Integrated Services' (AIS) December 5, 2016 Kettle Removal Work Plan
7. Exide's September 29, 2016 letter regarding Closure Plan Alternative 3, Mechanical Kettle Removal – Gantry System Method, including the September 26, 2016 Mechanical Kettle Removal - Gantry System Method report by Advanced GeoServices.

In addition, select topics related to overall implementation of Phase 1 closure from the forthcoming Implementation Plan are summarized below.

DECONSTRUCTION SEQUENCE AND AIR EMISSION CONTROLS

Deconstruction of the North Yard buildings will occur within Full Enclosure Units installed in segments. Segment 1 includes the western buildings (RMPS, Desulfurization and Reverb Furnace Feed Room). Segment 2 includes the eastern buildings (Smelter Building and Blast Furnace Feed Room), where the removal of the kettle lead would occur using the Gantry System. Segment 3 includes the center buildings (Baghouse Building and Corridor). The segments are shown on the Implementation Plan Figure 2 provided in Appendix 1. The Gantry System will be implemented within the Segment 2 Full Enclosure Unit as discussed in Advanced GeoServices' September 26, 2016 report. Please note that the segment layout in Appendix 1 was prepared based on the November 30, 2015 version of the Closure Plan, and Exide has not yet had a meaningful opportunity to review DTSC's approved Closure Plan or make associated modifications to the segment layout, if necessary. The final version of the segment layout will be submitted in the Implementation Plan.

The proposed sequence of building deconstruction is provided in the Deconstruction Engineering Survey prepared by a licensed professional engineer provided in Appendix 2. The Gantry System would be employed to remove the kettle lead at the point in time when the Full Enclosure Unit for Segment 2 is present, and the Smelter Building and Blast Furnace Feed Room have been deconstructed. Please note that the Deconstruction Engineering Survey in Appendix 2 was prepared based on the November 30, 2015 version of the Closure Plan, and Exide has not yet had a meaningful opportunity to review the approved Closure Plan or make associated modifications to the Deconstruction Engineering Survey, if necessary. The final version of the Deconstruction Engineering Survey will be submitted in the Implementation Plan.

The Full Enclosure Unit will be a combination of conventional scaffolding for the walls and a HAKI Truss System for the roof within each segment. The Full Enclosure Unit will enclose the segment of buildings proposed for deconstruction at that point in the Phase 1 closure. The HAKI system is a truss system capable of spanning the entire width of the structure and will provide enclosure by utilizing a track system within the trusses to place poly sheeting. The HAKI system will be used during the Phase 1 closure regardless of the selected kettle removal method. Information from the HAKI system manufacturer is provided in Appendix 3. Design drawings for the HAKI system prepared by a licensed professional engineer are also provided in Appendix 3. Please note that the HAKI system design drawings were prepared based on the November 30, 2015 version of the Closure Plan, and Exide has not yet had a meaningful opportunity to review the approved Closure Plan or make associated modifications to the HAKI system, if necessary. The final version of the HAKI system design drawings will be submitted in the Implementation Plan.

The Full Enclosure Unit will be installed and operating at each segment to provide negative air pressure prior to building deconstruction. The air within each Full Enclosure Unit will be managed by existing air emission control devices (i.e., baghouses), which are approved by the

South Coast Air Quality Management District (SCAQMD) and operated per the facility's Title V permit. Negative air machines and/or additional ducting from the existing baghouses will be added as necessary to maintain negative air pressure to prevent fugitive dust. Calculations prepared by a licensed professional engineer demonstrating that the air emission control equipment is appropriate for maintaining negative pressure in accordance with SCAQMD Rule 1420.1 are provided in Appendix 4. Please note that the calculations were prepared based on the November 30, 2015 version of the Closure Plan, and Exide has not yet had a meaningful opportunity to review the approved Closure Plan or make associated modifications to the calculations, if necessary. The final version of the calculations will be submitted in the Implementation Plan.

As discussed in Closure Plan Appendix G, Section 3.3.1, negative air pressure will be monitored per SCAQMD requirements using existing and temporary monitoring devices. In-draft velocity will also be measured. If the required negative air pressure is not met, SCAQMD Rule 1420.1 requires that work stop and the condition be corrected to restore the required negative air pressure. Work activities would stop and overhead doors would remain closed. Work would not resume until the required negative air pressure is restored.

Perimeter and real-time air monitoring will be conducted as indicated in Closure Plan Appendix G, Section 3.6. Procedures to stop work if an exceedance of perimeter ambient air concentrations occurs are provided in Closure Plan Appendix G, Section 3.6.1. Procedures to stop work if real-time air monitoring observes an increase in concentration of 50 $\mu g/m^3$ of PM10 occurs are provided in Closure Plan Appendix G, Section 3.6.2.

The Gantry System will be implemented using the aforementioned procedures in the Closure Plan, the materials attached to this letter and the Implementation Plan. These procedures, including air monitoring, dust control, and maintaining negative pressure and air emission controls, are adequate and consistent with the analysis presented in the Draft EIR, and meet SCAQMD requirements. As discussed in the September 26, 2016 Advanced GeoServices report, Section 3.2, "*The Gantry System Method reduces the air emission impacts of Alternative 3 [Mechanical Removal] presented in the Draft Environmental Impact Report.*"

ENGINEERING EVALUATION – EXISTING SLAB AND FOUNDATION

As Exide previously noted in its March 25, 2016 letter to DTSC regarding the Closure Plan, the Smelter Building concrete floor slab above the kettle gallery basement would not support the combined weight of a heavy-lift crane and a lead-filled kettle. For that reason, the modular rails that will support the Gantry System will not be placed on the unsupported Smelter Building floor slab. Instead, as shown on the cross-section sketch in Appendix 1, the modular rails will be laid down on both sides of the kettles, directly over load-bearing retaining walls at the edges of the Smelter Building basement. The header beams of the Gantry System will span the basement and will not rest on the floor. The bearing pressure of the gantry system will be placed on the structural retaining walls that create the basement below. These walls are bearing directly on the building foundation below and will support the gantry system.

The existing floor of the Blast Furnace Feed Room will support the gantry system, the kettle, its lead contents, the cribbing, and the excavator and other construction equipment as the existing floor is supported by soil as discussed in Appendix 6. The Blast Furnace Feed Room does not have a basement.

Supporting structural calculations for the aforementioned load bearing capacity of the walls and floors were prepared by a licensed engineer and are included in the AIS Kettle Removal Work Plan provided in Appendix 6.

ENGINEERING EVALUATION – RINGS

Exide previously noted in its August 1, 2016 letter to DTSC that a specially designed lifting sling would be required to lift the lead-filled kettles when implementing a crane removal method due to the risk that the lifting rings on the kettles might not have sufficient lifting capacity. These statements were based on a preliminary evaluation, and not an analysis by a structural engineer. Since that time, a structural engineer has evaluated the kettle design, including steel type, size and construction, and determined that the existing lifting rings will support the lead-filled kettles with an adequate factor of safety. The evaluation is provided in the AIS Kettle Removal Work Plan in Appendix 6. While not anticipated to be necessary, if the existing lifting rings are not adequate, a contingency method would implemented as discussed in Appendix 6. The contingency method would include creating additional lifting points by drilling through the kettle gussetts. Adding lifting points would increase the safety factor so that the kettles can be lifted safely.

CRIBBING

Cribbing will be used to secure the kettle once it has been placed on the existing concrete in the Blast Furnace Feed Room to secure it during cutting and lead removal activities. Cribbing information is provided in the AIS Kettle Removal Work Plan in Appendix 6.

EQUIPMENT EVALUATION – CUTTING OF KETTLE AND LEAD

The proposed kettle cutting and lead slicing equipment is adequate to perform the work. An evaluation of the equipment is provided in Appendix 6.

DUST SUPPRESSION METHODS

Dust suppression during the use of the Gantry System will be conducted in accordance with the methods in Closure Plan Appendix G, Section 3.4.1.

HEALTH AND SAFETY PLAN

The Implementation Plan will include a site-specific Phase 1 Closure Health and Safety Plan which applies to all Phase 1 closure activities. The portions of the Phase 1 Closure Health and Safety Plan related specifically to the Gantry System are provided in Appendix 6. The AIS Kettle Removal Work Plan in Appendix 6 includes Job Safety Hazard Analyses (JHA) specific to the tasks associated with the use of the Gantry System. The JHAs were prepared by AIS and the Gantry System subcontractor, Bigge Crane. Topics include specialized rigging, decontamination, deconstruction, scaffold/enclosure construction, and use of construction saws. JHAs will be reviewed in the field at the time of work and may be modified. The JHAs related to the Gantry System will also be included in the Phase 1 Closure Health and Safety Plan submitted with the Implementation Plan.

SCHEDULE AND SEQUENCE

The Implementation Plan will include a schedule for all Phase 1 Closure activities. The AIS Kettle Removal Work Plan in Appendix 6 includes a schedule specific to the Gantry System tasks. The schedule includes the sequence of work.

BUILDING AND KETTLE REMOVAL SEQUENCE

DTSC's November 29, 2016 letter states that DTSC would prefer that the kettles be removed before the Smelter Building or Blast Furnace Feed Room are deconstructed to maintain redundant air emissions, and requests logistical and/or technical reasoning why deconstruction of the building before removal of the kettles is necessary, and how the public, workers and/or the environment will be protected.

The Gantry System cannot be installed or employed until the Smelter Building and Blast Furnace Feed Room have been fully deconstructed, due to the presence of structural components of the buildings and the units and equipment located within the buildings. As indicated in the September 26, 2016 Gantry System Method report, Section 2.1, '*…Advanced GeoServices and Exide evaluated an alternative sequencing that placed the installation of the gantry system before decontamination and deconstruction of … the Smelter Building itself. However, the presence of structural building elements … would constrain operational space and prevent the use of a gantry system and thus the alternative sequencing was infeasible.*' Exide conducted a field evaluation of the structural building elements in the area of the seven kettles and proposed Gantry System. Even if the units and equipment within the Smelter Building and Blast Furnace Feed Room had been decontaminated and deconstructed and the buildings were empty, several structural elements associated with the Smelter Building and Blast Furnace Feed Room would prevent installation of the Gantry System, as shown in Appendix 5. These elements include the building columns along Lines B and C, the concrete wall between the Smelter Building and Blast Furnace Feed Room and the concrete walls which separate storage areas in the Blast Furnace Feed Room.

Therefore, partial deconstruction of the Smelter Building and Blast Furnace Feed Room (i.e., deconstruct only those portions conflicting with the gantry system) is not feasible as it would not satisfy the requirements of the Deconstruction Engineering Survey to achieve a safe deconstruction, as well as creating an unstable building and unsafe work conditions.

In addition, the southern wall of the Smelter Building would have to be removed to allow the kettles to be transported on the modular rails from the Smelter Building to the Blast Furnace Feed Room. However, once that wall was removed, the building would no longer act as an enclosure, and the redundant air emission controls suggested by DTSC would no longer be present, so that the Segment 2 Full Enclosure Unit would provide control of fugitive emissions.

Deconstruction of the Smelter Building and Blast Furnace Feed Room before removal of the kettles is logically and technically necessary for implementation of the Gantry System. Protection of the public, workers and the environment will be provided by the Segment 2 Full Enclosure Unit operated under negative air pressure as described above and as provided in Appendices 3 and 4.

OFFSITE RE-USE OF KETTLES

DTSC's November 29, 2016 letter asks if the Gantry System would allow for kettles with more than 12 tons of lead to be re-used offsite at an alternate facility. However, Exide does not propose to keep the seven kettles containing more than 12 tons of lead intact, nor would the seven kettles be transported to an alternate facility for re-use. Instead, the methodology proposed by Exide includes cutting the kettle to remove it from the lead, after which the kettle could not be re-used.

We appreciate DTSC's review of the enclosed information, and look forward to its formal approval of the Gantry System by December 27, 2016. Please contact me at (323) 262 1101 x275 with any questions.

Sincerely,

J Hogarth

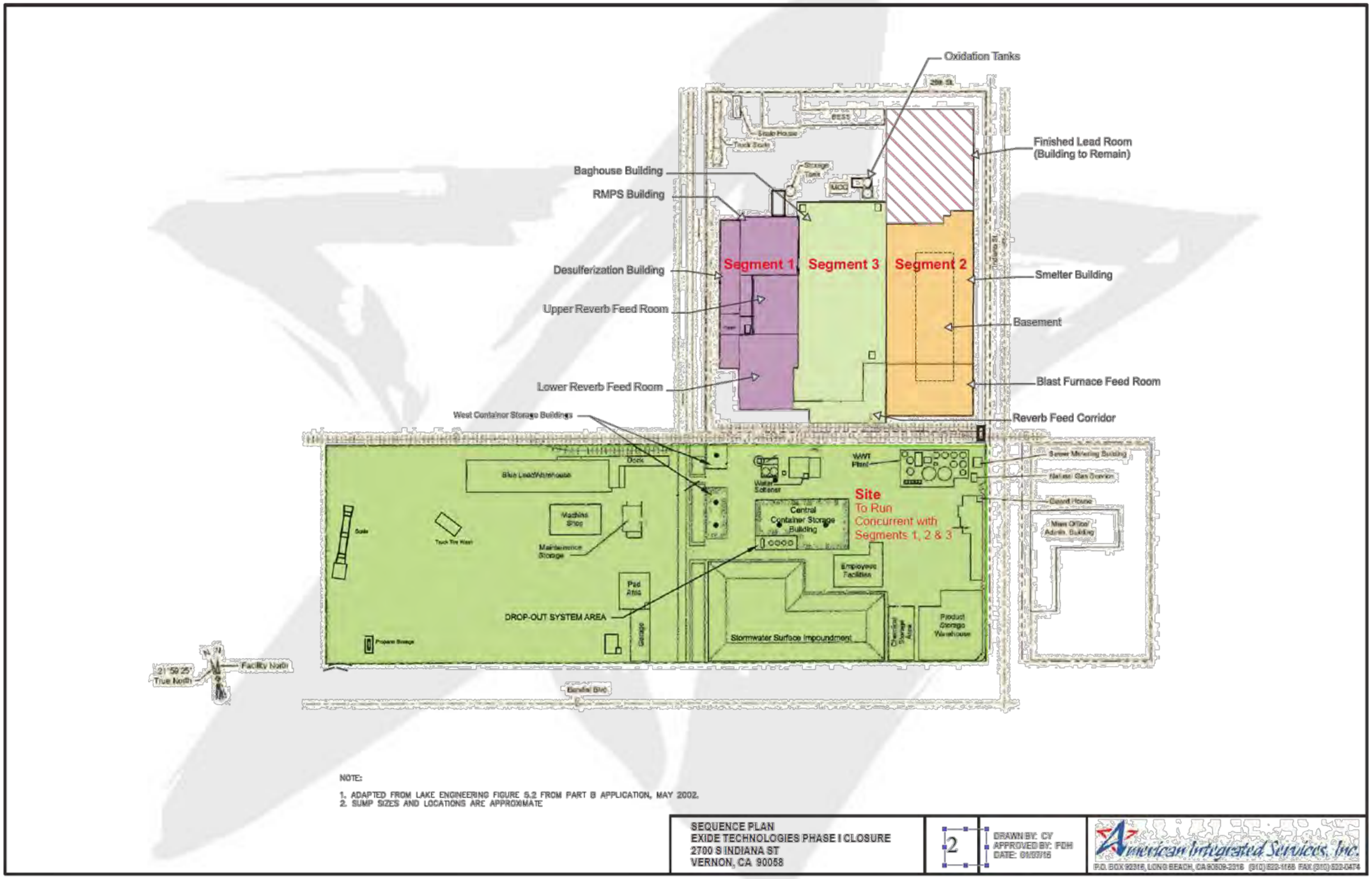
John Hogarth
Exide Vernon
Plant Manager

cc: Peter Ruttan (electronic)
Matthew Wetter (electronic)
Wayne Lorentzen (electronic)
Paul Stratman (electronic)
Jennifer DiJoseph (electronic)
Dan Henke (electronic)
Gwen Tellegen (1 hard copy and electronic)
Nicolas Serieys (1 hard copy and electronic)

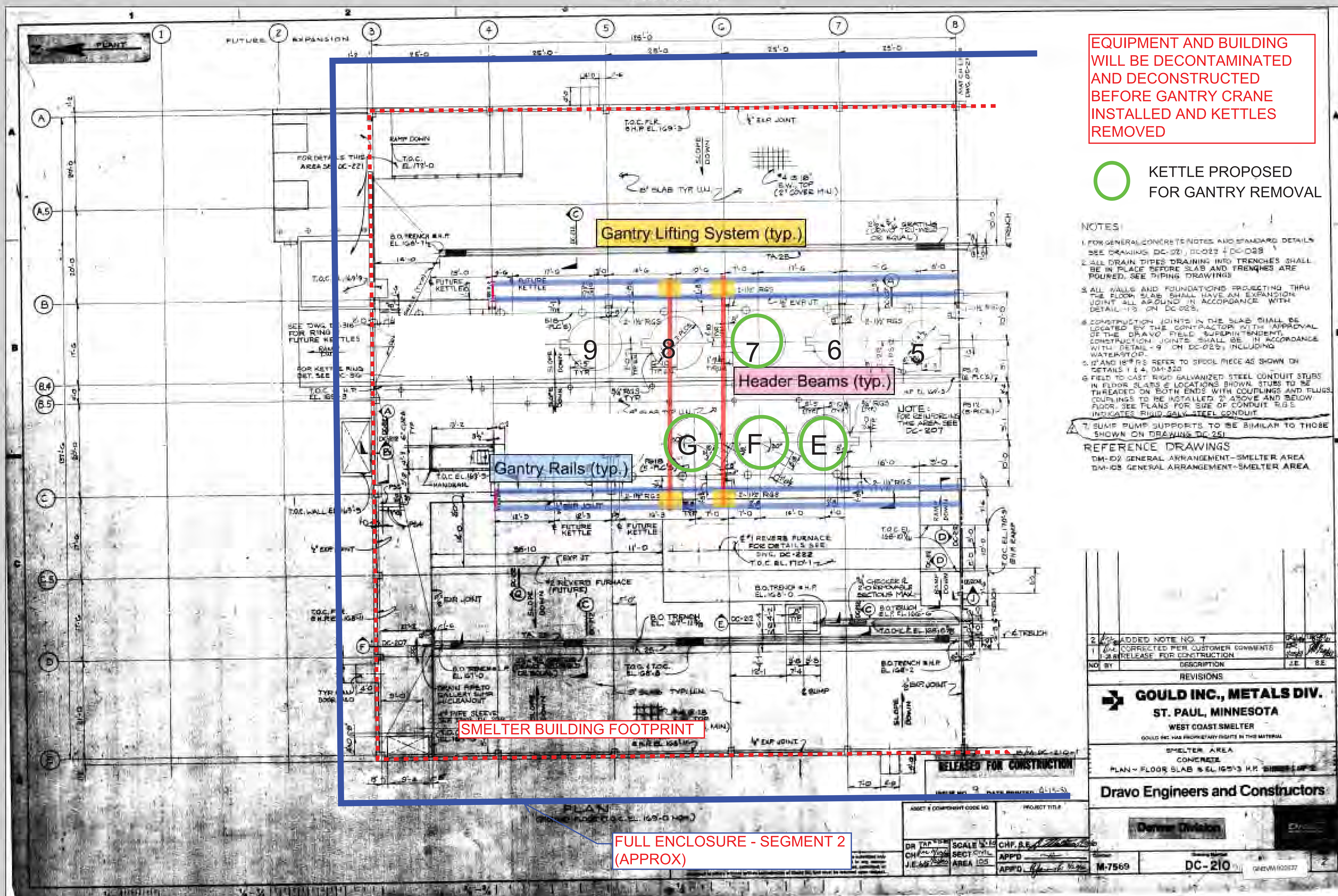
APPENDIX 1

FIGURES

Figure 2 – Sequencing Plan

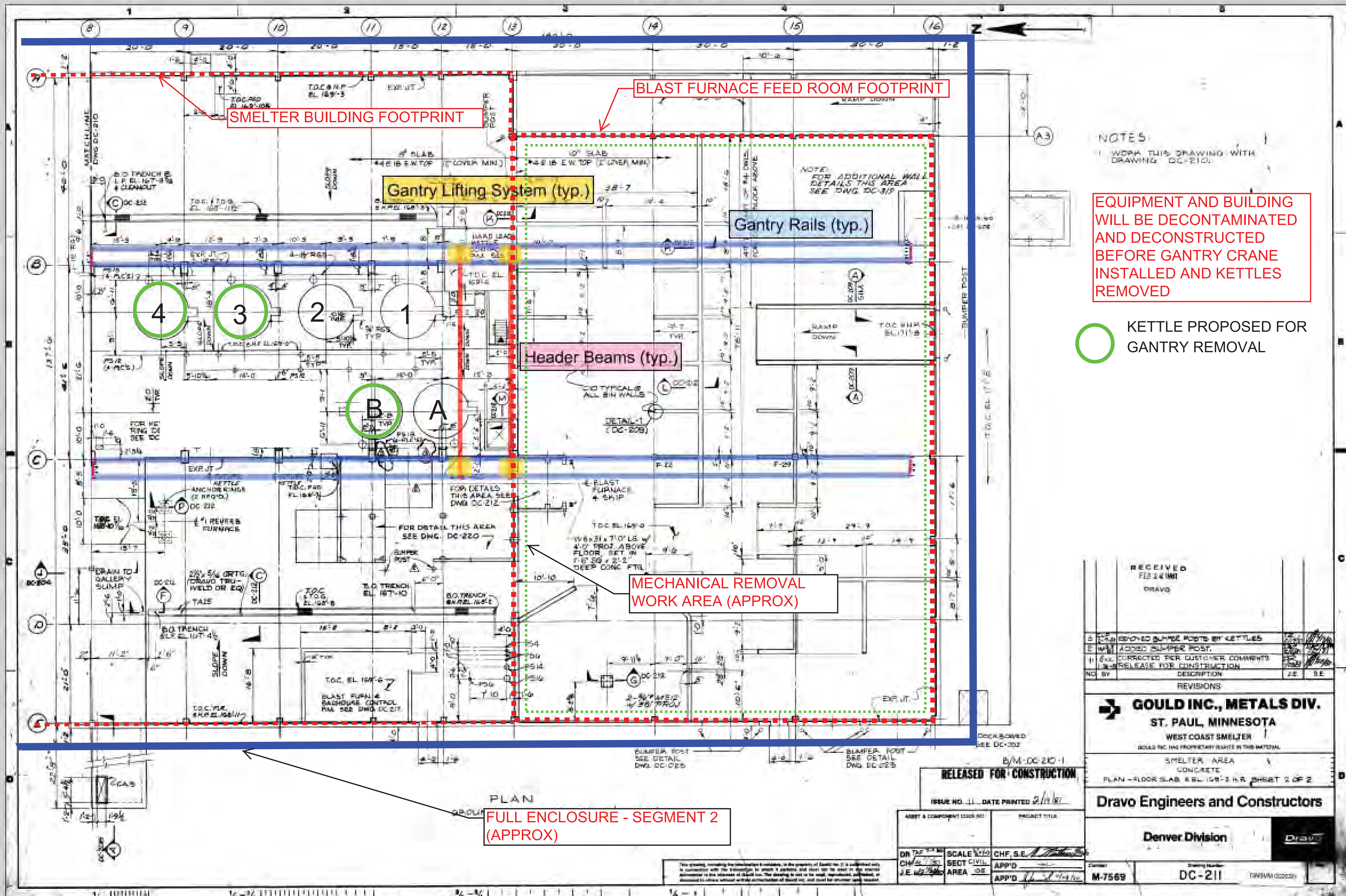


36.00 x 24.06



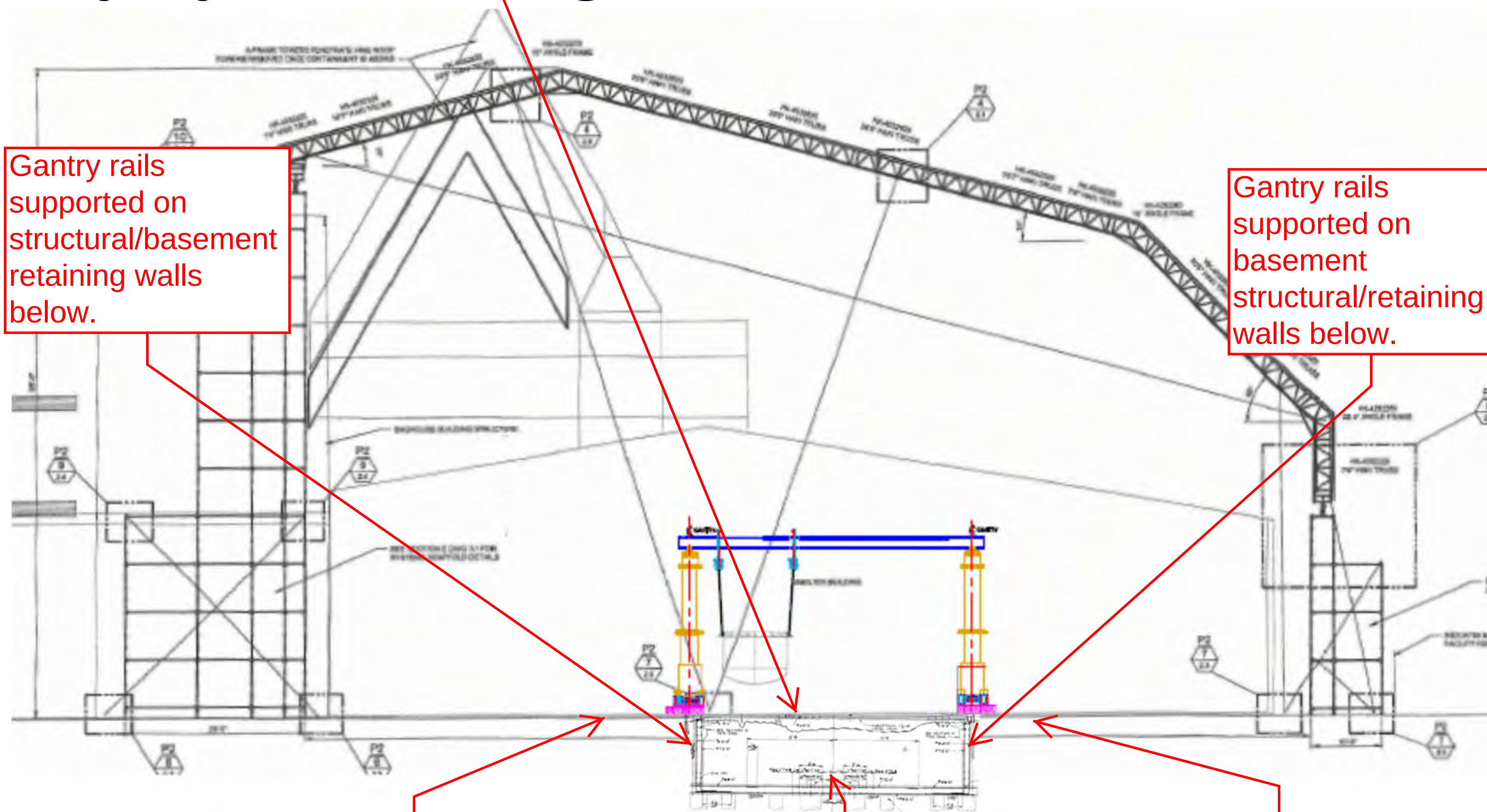
Measurement Type : Imperial

36.00 x 24.06



Measurement Type : Imperial

Gantry System Lifting Kettle Within Enclosure



APPENDIX 2

DECONSTRUCTION ENGINEERING SURVEY

REFER TO

IMPLEMENTATION PLAN

ATTACHMENT 4

DECONSTRUCTION ENGINEERING SURVEY

APPENDIX 3

HAKI SYSTEM

REFER TO

IMPLEMENTATION PLAN

ATTACHMENT 8

FEU – HAKI TRUSS SYSTEM

APPENDIX 4

AIR EMISSION CONTROL CALCULATIONS

REFER TO

IMPLEMENTATION PLAN

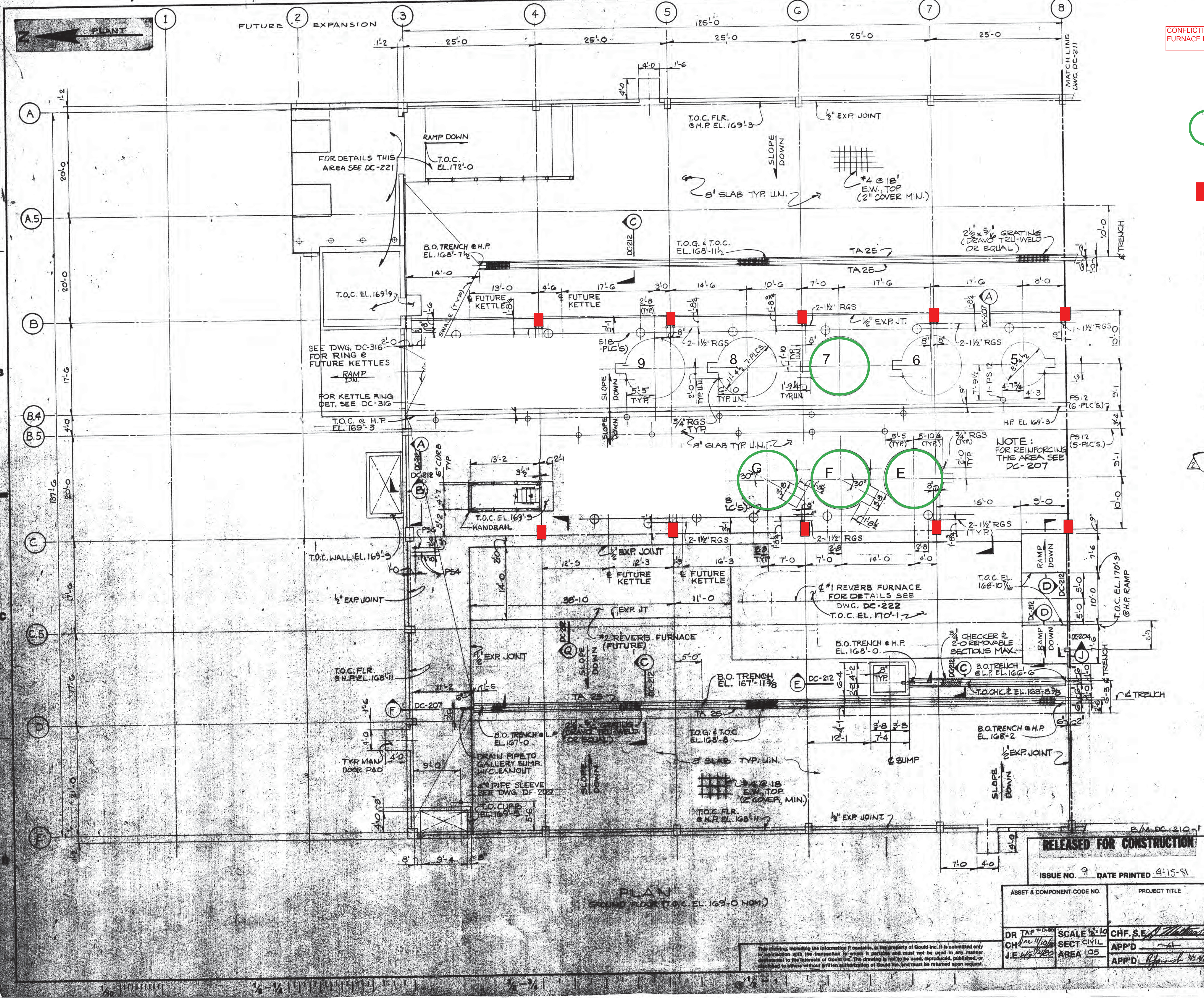
ATTACHMENT 10

DUCTING PLANS

APPENDIX 5

CONFLICTING STRUCTURAL BUILDING ELEMENTS

CONFLICTING STRUCTURAL ELEMENTS OF THE SMELTER BUILDING AND BLAST FURNACE FEED ROOM ARE SHOWN IN RED



KETTLE PROPOSED FOR GANTRY REMOVAL

CONFLICTING STRUCTURAL BUILDING ELEMENT

NOTES:

1. FOR GENERAL CONCRETE NOTES AND STANDARD DETAILS SEE DRAWING DC-021, DC-022 & DC-023
2. ALL DRAIN PIPES DRAINING INTO TRENCHES SHALL BE IN PLACE BEFORE SLAB AND TRENCHES ARE POURED. SEE PIPING DRAWINGS
3. ALL WALLS AND FOUNDATIONS PROJECTING THRU THE FLOOR SLAB SHALL HAVE AN EXPANSION JOINT ALL AROUND IN ACCORDANCE WITH DETAIL -13 ON DC-023.
4. CONSTRUCTION JOINTS IN THE SLAB SHALL BE LOCATED BY THE CONTRACTOR WITH APPROVAL OF THE DRAVO FIELD SUPERINTENDENT. CONSTRUCTION JOINTS SHALL BE IN ACCORDANCE WITH DETAIL -9 ON DC-023, INCLUDING WATERSTOP.
5. 12" AND 18" Ø P.S. REFER TO SPOOL PIECE AS SHOWN ON DETAILS 1 & 4, DM-320
6. FIELD TO CAST RIGID GALVANIZED STEEL CONDUIT STUBS IN FLOOR SLABS @ LOCATIONS SHOWN. STUBS TO BE THREADED ON BOTH ENDS WITH COUPLINGS AND PLUGS. COUPLINGS TO BE INSTALLED 2" ABOVE AND BELOW FLOOR. SEE PLANS FOR SIZE OF CONDUIT. R.G.S. INDICATES RIGID GALV. STEEL CONDUIT.
7. SUMP PUMP SUPPORTS TO BE SIMILAR TO THOSE SHOWN ON DRAWING DC-251

REFERENCE DRAWINGS

DM-102 GENERAL ARRANGEMENT~SMELTER AREA
DM-103 GENERAL ARRANGEMENT~SMELTER AREA

NO	BY	DESCRIPTION	J.E.	S.E.
2	4-15-81	ADDED NOTE NO. 7		
1	1-28-81	CORRECTED PER CUSTOMER COMMENTS RELEASE FOR CONSTRUCTION	1/28/81	1/28/81

REVISIONS

GOULD INC., METALS DIV.
ST. PAUL, MINNESOTA
WEST COAST SMELTER
GOULD INC. HAS PROPRIETARY RIGHTS IN THIS MATERIAL

SMELTER AREA
CONCRETE
PLAN ~ FLOOR SLAB @ EL. 169'-3 H.P. SHEET 1 OF 2

RELEASED FOR CONSTRUCTION
ISSUE NO. 9 DATE PRINTED 4-15-81

ASSET & COMPONENT CODE NO. | PROJECT TITLE

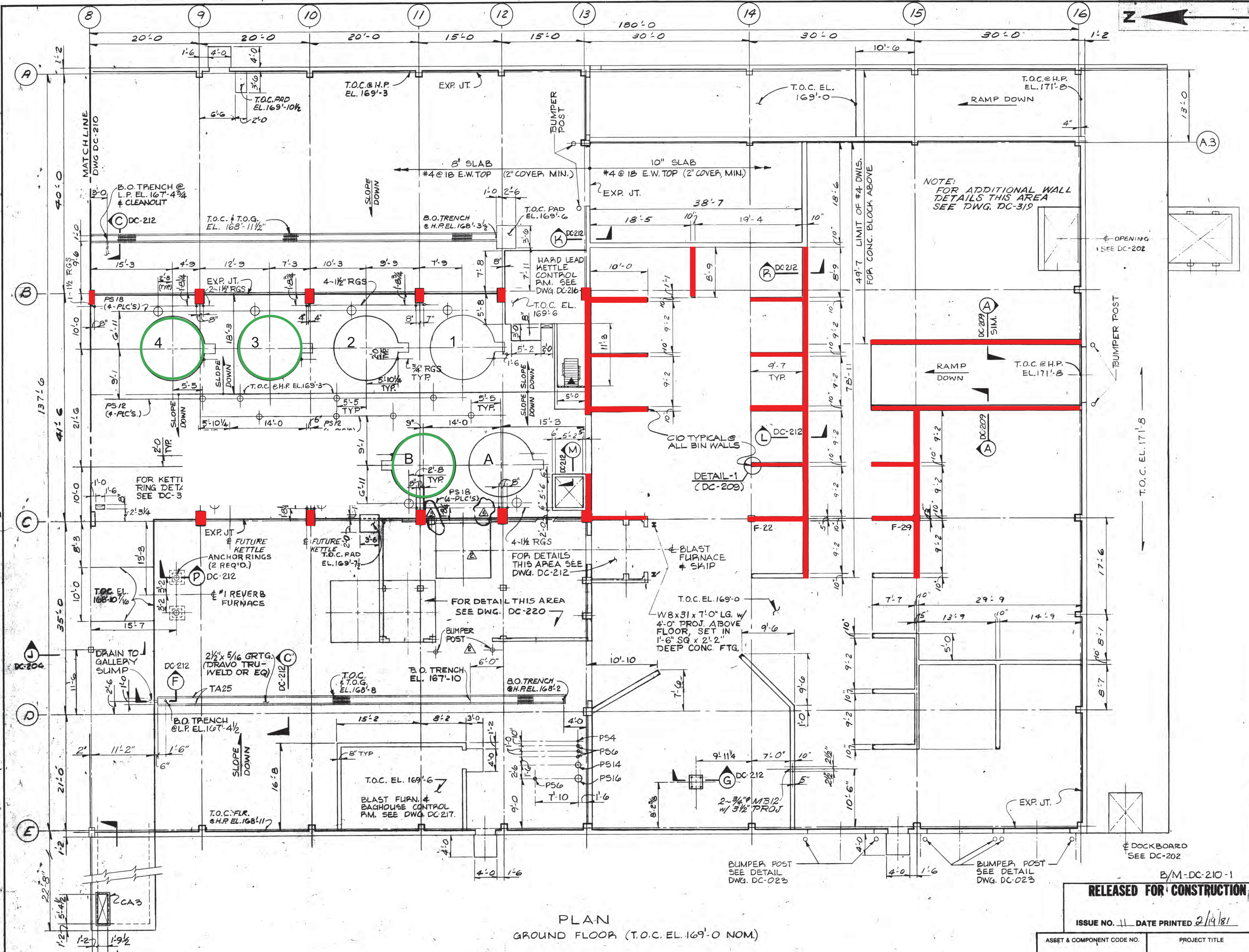
DR TAF 9-17-80 | CH 11/10/80 | J.E. | SCALE 1/8"=1'-0" | SECT CIVIL | AREA 105 | CHF. S.E. | APP'D | APP'D

Dravo Engineers and Constructors
Denver Division

Contract M-7569
Drawing Number DC-210
2

This drawing, including the information it contains, is the property of Gould Inc. It is submitted only in connection with the transaction to which it pertains and not to be used in any manner detrimental to the interests of Gould Inc. The drawing is not to be used, reproduced, published, or disclosed to others without written authorization of Gould Inc. and must be returned upon request.

GNBVM 002637



NOTES:

1. WORK THIS DRAWING WITH DRAWING DC-210.

CONFLICTING STRUCTURAL ELEMENTS OF THE SMELTER BUILDING AND BLAST FURNACE FEED ROOM ARE SHOWN IN RED

KETTLE PROPOSED FOR GANTRY SYSTEM REMOVAL

CONFLICTING STRUCTURAL BUILDING ELEMENT

RECEIVED FEB 24 1981 DRAVO

NO	BY	DESCRIPTION	J.E.	S.E.
3		REMOVED BUMPER POSTS BY KETTLES		
2		ADDED BUMPER POST.		
1		CORRECTED PER CUSTOMER COMMENTS		
		RELEASE FOR CONSTRUCTION		

REVISIONS

GOULD INC., METALS DIV.
ST. PAUL, MINNESOTA
WEST COAST SMELTER
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SMELTER AREA
CONCRETE
PLAN ~ FLOOR SLAB @ EL. 169'-3 H.P. SHEET 2 OF 2

B/M-DC-210-1

RELEASED FOR CONSTRUCTION

ISSUE NO. 1 DATE PRINTED 2/19/81

Dravo Engineers and Constructors
Denver Division

ASSET & COMPONENT CODE NO. | PROJECT TITLE

DR TAF | SCALE 3/8"=1'-0 | CHF, S.E.
CH | SECT CIVIL | APP'D
J.E. | AREA 105 | APP'D

Contract M-7569
Drawing Number DC-211

GNBVM 002636

APPENDIX 6

AIS KETTLE REMOVAL WORK PLAN

Kettle Removal Work Plan

Phase I Decontamination and Deconstruction Project
Vernon, CA 90058

Prepared for

Exide Technologies

2700 South Indiana Street
Vernon, CA 90058

Prepared by

American Integrated Services, Inc.

1502 E Opp
Wilmington, CA 90744

December 2, 2016

Contents

P.O. Box 92316, Long Beach, CA 90809-2316 • 1502 E. Opp St., Wilmington, CA 90744-3927
Phone: 310.522.1168 • 888.423.6060 • Fax 310-522-0474
www.americanintegrated.com • Contractors License #757133

Kettle Removal

This work plan provides additional implementation information for the Gantry System Method discussed in Exide's September 29, 2016 submission. This work plan applies to removal of seven kettles containing hardened lead that are too heavy to be removed with the existing Smelter Building cranes, specifically Kettles B, E, F, G, 3, 4, and 7. Prior to implementation of this work plan, the Segment 2 Full Enclosure will have been installed, and the former Interim Status units and equipment and Smelter Building and Blast Furnace Feed Room will have been decontaminated and deconstructed. Sketches of the gantry system layout are provided in Attachment A.

American Integrated Services Intends to use the services of Bigge Crane – Rigging & Transportation Division of La Mirada, California for Installation and operation of the Lift-N-Lock 1400 Series Hydraulic Boom Gantry or equivalent. Equipment information is provided in Attachment B. The gantry system power pack includes a 68 horsepower diesel engine which is compliant with California Air Resources Board (CARB) requirements. Bigge Crane's gantry system design is also provided in Attachment B. The gantry system design includes plan views, isometric view, and cross-section drawings of the gantry system and its track assembly and engineering calculations.

Paired with Bigge's in-house engineering staff, Sigma Engineering of Las Vegas, NV has verified the existing Smelter Building and Blast Furnace Feed Room slabs, the Smelter Building basement walls, and underlying soil have enough integrity to withstand the combined weights of the Gantry system and kettles. Post and beam shoring is required for Smelter Building floor support where the gantry rail crosses over tunnels (where columns lines C and 8 intersect and where B and 13 intersect as shown in Attachment A). Sigma Engineering's evaluation is provided in Attachment C.

Health and safety procedures, including daily safety meetings, personal protective equipment, personnel air monitoring, and emergency procedures, will be conducted in accordance with the AIS Health and Safety Plan, which will be submitted as Attachment 4 of the AIS Implementation Plan. Example Job Hazard Analyses (JHA) for specialized rigging, decontamination, deconstruction, scaffold/enclosure construction and use of construction saws are provided in Attachment D. JHAs and potential hazards will be reviewed daily with field personnel prior to conducting the work, and JHAs will be modified as needed based on field conditions.

Several weeks prior to any kettle removal work, AIS will conduct a pre-work site meeting including the AIS Project Manager, AIS Supervisor, AIS H&S Director, Bigge personnel, Sigma's engineer, Exide, the Construction Manager, and the Resident Engineer/QA Official to ensure that all existing site conditions are consistent with assumptions and review remaining safety concerns. Regulatory agency field representatives will also be invited to attend. The Post and beam shoring required for floor support where the Gantry rail crosses over tunnels (where column lines C and 8 intersect and where B and 13 intersect as shown in Attachment A) will be discussed along with general Gantry layout and work area limits. A shop drawing for shoring will be prepared prior to the pre-work site meeting. Working areas will be marked with white paint at this time also.

Once mobilized, crews will begin installing the gantry crane system. Timber cribbing and/or matting for two parallel 4' wide rail sets will be placed on the concrete slab running the length of the anticipated path of travel along column lines B & C shown in the sketches in Attachment A. The I-beam type railing will be set on top of the timber cribbing and/or matting in 10' or 20' sections and fastened to each other by bolts through the welded tabs on each end. The I-beam railing is designed to be held in place by the weight of the gantry system and is not fastened to the existing floor. Drawings for the I-beam railing are provided in Attachment B. The I-beam railing will be located directly over the load-bearing walls at the edges of the Smelter Building basement. The four Gantry lift housing assemblies will be mounted onto the railing, aligned, and leveled. Drawings of the lift housing assemblies are provided in Attachment B. After the four Gantry lift housing assemblies are placed on the railing and levelness has been checked, the control module with hydraulic pressure hoses, cylinders, drive system, and cam locks will be laid out and installed. Next, after all system testing is complete, the four Gantry lift housing assemblies will be aligned and Connecting and Lift beams will be set on top and bolted to the Gantry lift housing assemblies as shown in Attachment B. In addition to being bolted to the Gantry lift housing assemblies, stabilizer bars may be attached between the lift beams and lift housing assemblies to assist in preventing any sway while under load. Drawings of the connecting and lift beams and stabilizer bars are provided in Attachment B.

After all systems have been checked for correct installation and operation, crews will begin at the lightest kettle (Kettle G) first then decide which kettles to remove based on field observations. A rigging system will be used to connect the kettle to the gantry system. The rigging system will consist of shackles and a wire rope assembly that will be attached to a minimum of four equidistant lifting lugs located around the top ring of the kettle. An engineering evaluation has been conducted which indicates that the existing lifting rings can be used in their current condition or with minimal modifications. The evaluation is provided in Attachment C.

The kettle will be inspected for proper rigging and verification that it is clear of any obstacles that may prevent it from being lifted. Next, the kettle will be lifted vertically until it is clear of its setting, moved laterally (west or east) to the center of its primary path of travel, then transported south and lowered onto timber cribbing at the former Blast Furnace Feed Room floor.

After a kettle is delivered to the former Blast Furnace Feed Room, it will be placed in structurally welded or bolted cribbing and held in an upright position. See Attachment E for a preliminary sketch of the cribbing design. The cribbing will support the kettle during cutting and lead removal activities. The cribbing is designed to be self-supporting and does not need to be anchored to the floor. Modifications may be required based on field conditions. The existing floor of the Blast Furnace Feed Room will support the gantry system, kettle, kettle contents, cribbing, excavator and other construction equipment as the existing floor is supported by soil as discussed in Attachment C. The Blast Furnace Feed Room does not have a basement.

Depending on the volume of lead in the kettle, crews will then begin cutting the kettle steel (approximately 1 1/2" thick) using either powered hand saws and blades, shear, and/or excavator-mounted breaker with impact cutter tip. A typical powered hand saw (Hilti Models DSH700 and DSH900) is provided in Attachment F. AIS has successfully used Hilti Model DSH700 and DSH900 cutting saws, and equivalents, to cut steel of 1 ½" and greater thickness. All workers will utilize required safety equipment and have specific training for use of selected cutting saws. AIS will cut the kettle into approximately 1/8 sections. Cutting will begin at the top and progress downward stopping approximately 28" from the bottom of the kettle, then a lateral cut will be made beginning where the vertical cut stops to complete separating the section. Because each kettle has a different amount of lead remaining in it, size and number of sections to be removed will be determined in the field. A typical cutting pattern is provided in Attachment G. The exposed lead will be hammered out via an excavator with breaker attachment and standard or chisel-shaped tips. Lead will be removed below the cut line of the remaining 28" kettle bottom. Next the kettle bottom will be inverted and hammered from above with breaker attachment until the lead "heel" is loosened and falls away. This last lead piece will be separated into large sections and prepared for removal. The excavator breaker attachment is BXR120, or similar as shown in Attachment H. The BXR120 applies 12,000 ft-lbs of force to cut lead. Exide's plant experience shows that a demolition tool such as a jack-hammer with 60 ft-lbs of force can easily cut lead. As the BXR120 applies significantly greater force than tools which have been proven to cut lead (i.e., 12,000 ft-lbs is greater than 60 ft-lbs), the BXR120 excavator attachment is adequate to cut the lead.

Removed lead will be collected by skid steer with grapple bucket or excavator with bucket and thumb attachments and placed inside awaiting roll-offs or on a flat bed trailer. When the transport vehicle has been loaded, they will be decontaminated and moved to the Corridor and await transport. The remaining kettle sections will be decontaminated and loaded into roll-offs then transported off-site. Loading, preparation for transport, and transport for off-site disposal or recycling will be conducted per the Closure Plan, including Closure Plan Appendix G.

The kettle housings associated with the seven kettles will be decontaminated and removed. The Smelter Building and Blast Furnace Feed Room floor slab footprint used for kettle removal and cutting will be decontaminated. The Segment 2 Full Enclosure will be removed.

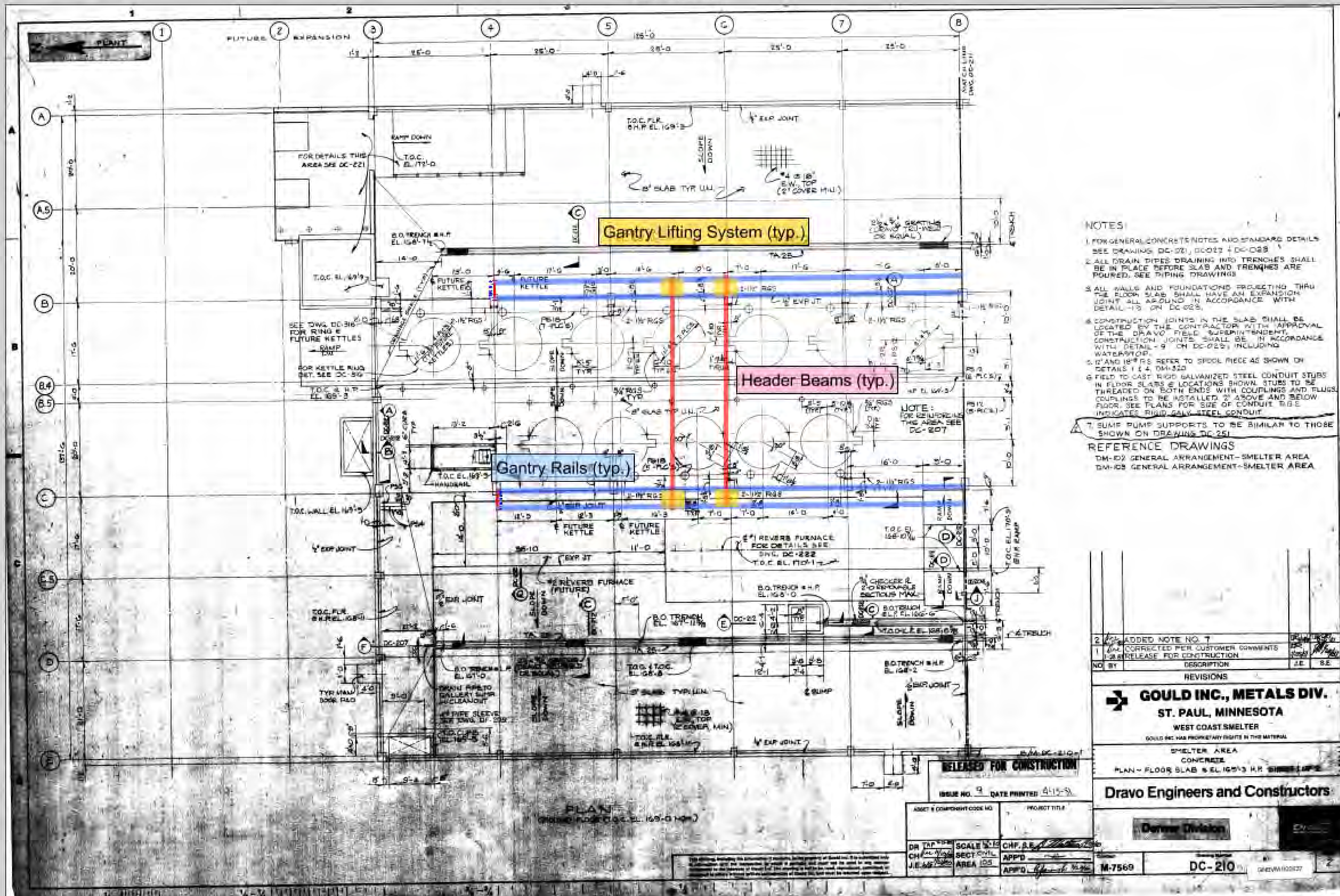
P.O. Box 92316, Long Beach, CA 90809-2316 • 1502 E. Opp St., Wilmington, CA 90744-3927
Phone: 310.522.1168 • 888.423.6060 • Fax 310-522-0474
www.americanintegrated.com • Contractors License #757133

Schedule

As indicated in the AIS Implementation Plan, AIS's work schedule is four days per week (Monday through Thursday), 10-hours per day. Gantry system mobilization and installation is anticipated to require approximately 9 work days. Once the system has been installed, kettle removal and movement to the Blast Furnace Feed Room is anticipated to require 14 work days. Cutting of the kettle and lead and loading of transport vehicles will begin when the first kettle is moved to the Blast Furnace Feed Room, and will occur concurrent with movement of the remaining kettles. The overall schedule for the Gantry System Method is approximately 22 work days or approximately six 4-day weeks. Please see Attachment I for a preliminary schedule.

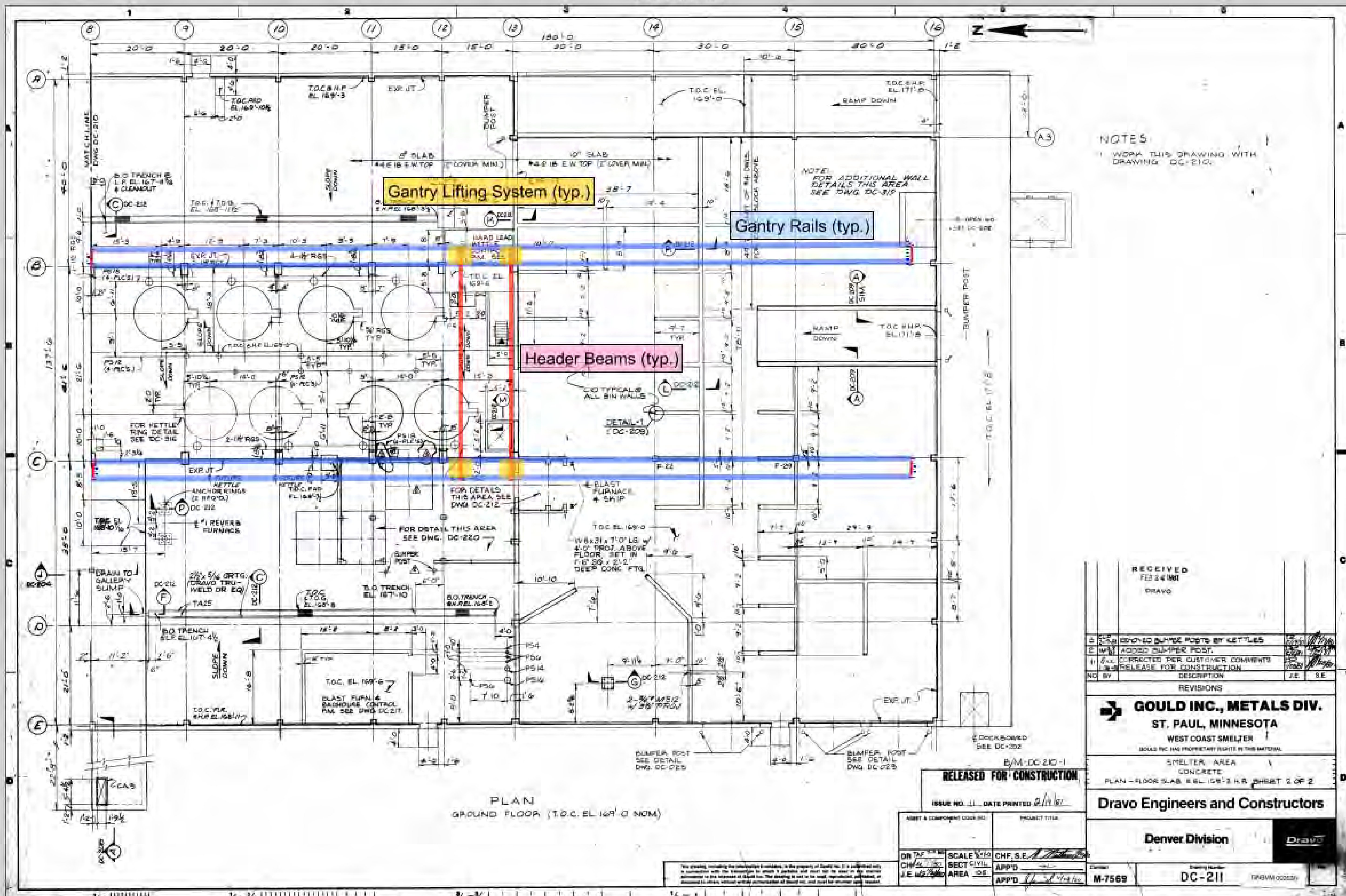
Attachment A

Sketches



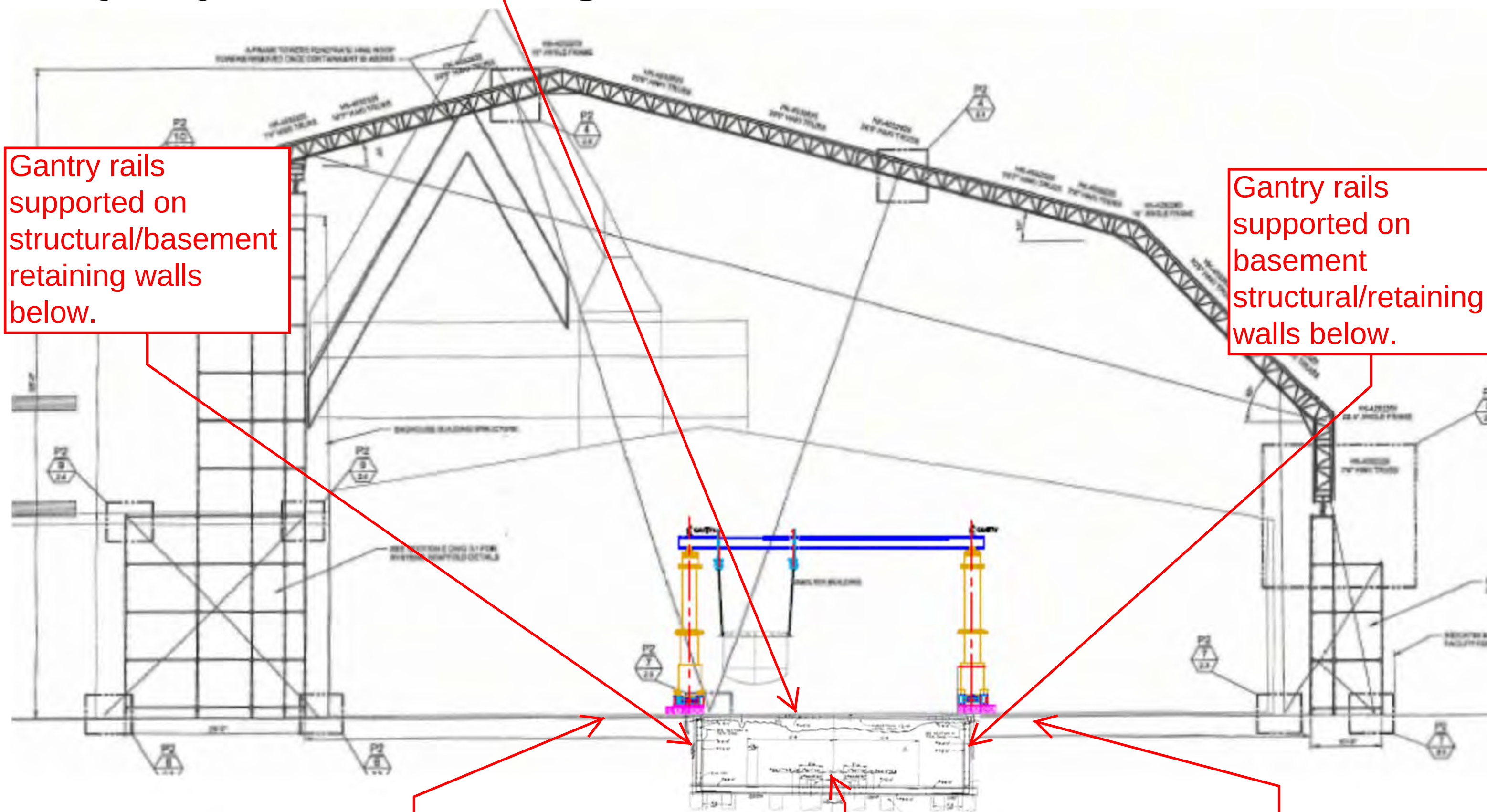
Measurement Type : Imperial

36.00 x 24.06



Measurement Type : Imperial

Gantry System Lifting Kettle Within Enclosure



Attachment B

Bigge Gantry System

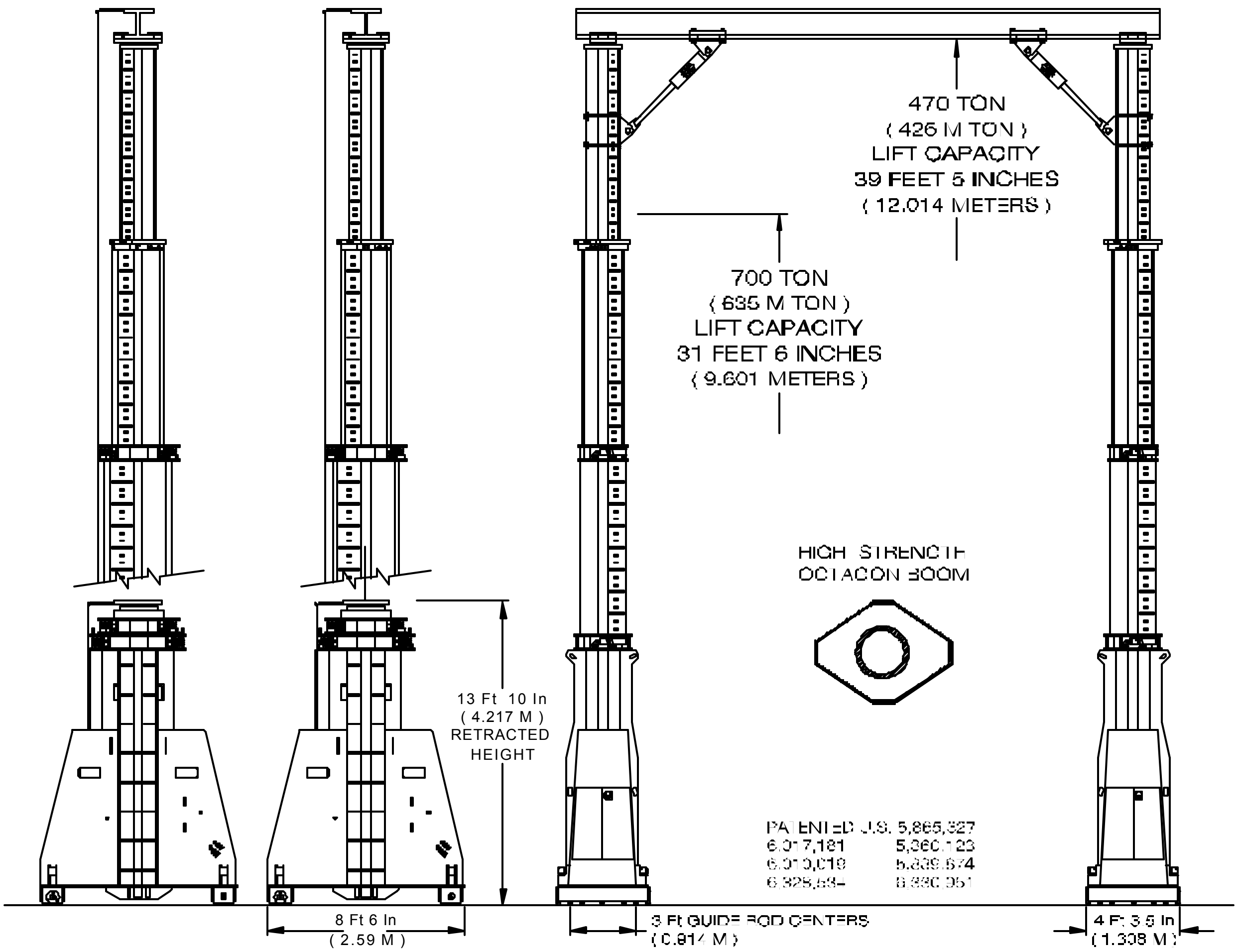
1400 SERIES

LIFT-N-LOCK®

TELESCOPIC OCTAGON BOOM GANTRY

MODEL T1402-4-39

FOUR LIFT HOUSINGS



STANDARD EQUIPMENT

*Independent Control Module
*Automatic Cam Lock System
*Power Up and Down Cylinders
*Integral Lift Cylinder Lock Valves
*Telescopic Octagon Booms
*Two Speed Extension System
*Oscillating / Rotating Header Plates
*Pressure Compensated Piston Pump
*Continuous Planetary Self Propel
*Diesel, Propane or Electric Power
*Synchronized Proportional Control
*Full Power Manual Boom Sections

OPTIONAL EQUIPMENT

*Lifting Links
*Stabilizer Bars
*Propel Track / Lift Beams
*Bolt On Boom Extensions
*Digital Height Indicator System
*Self Propelled Beam Powerlinks

J & R Engineering Company, Inc.
538 Oakland Avenue
P.O. Box 447
Mukwonago, WI 53149 U.S.A.

262-363-9660
800-466-RSVP
FAX 262-363-9620
E-MAIL / jreng@execpc.com

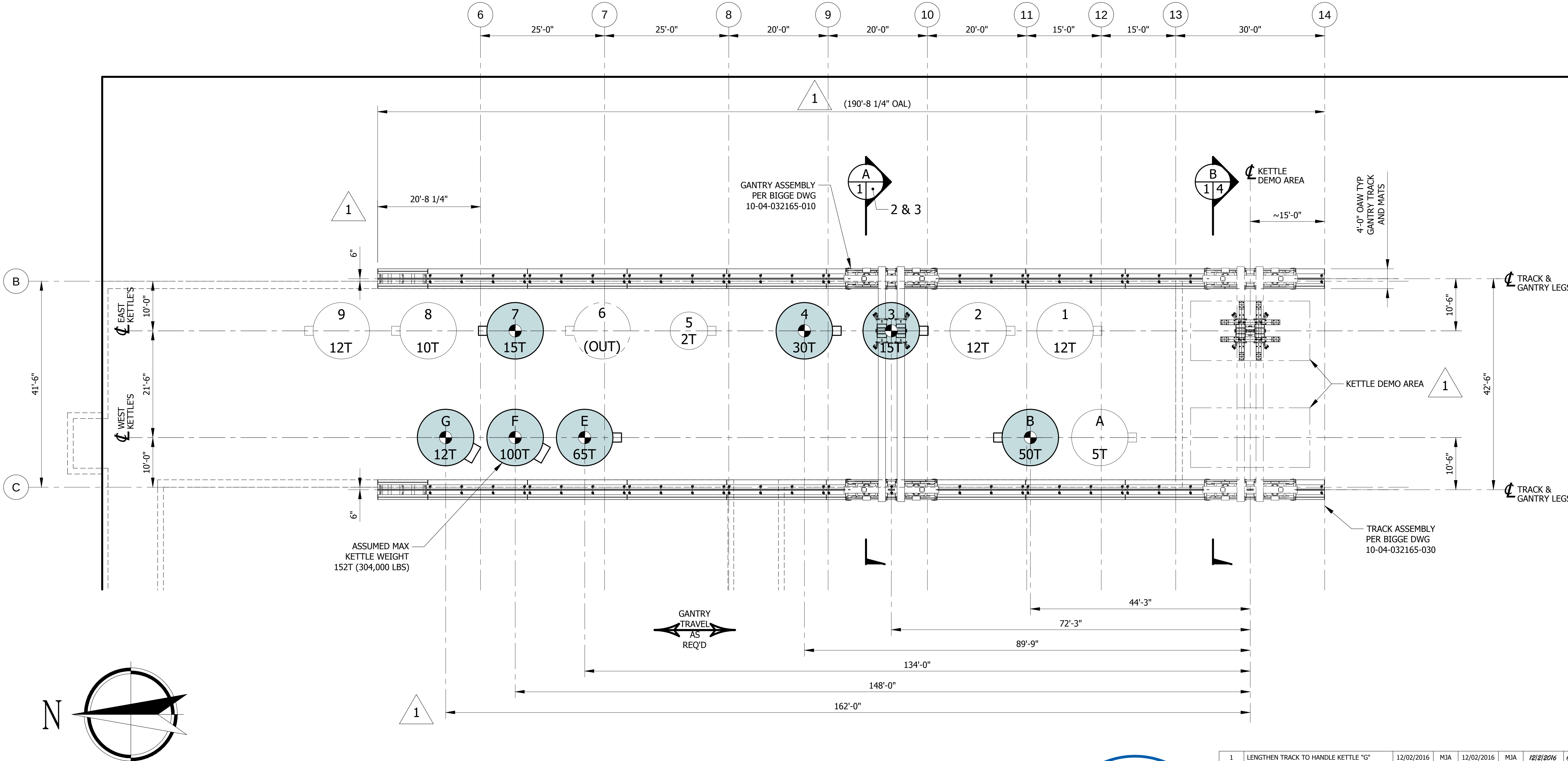
SPECIALIZED LIFTING AND TRANSPORTATION EQUIPMENT

LIFT-N-LOCK HYDRAULIC BOOM GANTRY SPECIFICATIONS

MODEL # T1402-4-39

DESCRIPTION	SPECIFICATIONS
LIFT HOUSING WEIGHT	22,300 LBS. (RETRACTED); 22,855 LBS. (EXT.)[1]
LIFT HOUSING LENGTH	108" / 2.743 M
LIFT HOUSING WIDTH	51.625" / 1.311 M
RETRACTED HEIGHT	166" (13'-10") / 4.216 M
MANUAL EXTENDED	272.5" (22'-8.5") / 6.921 M
1st STAGE EXTENDED	273" (22'-9") / 6.934 M
1st STAGE & MANUAL EXTENDED	379.5" (31'-7.5") / 9.662 M
2nd STAGE & 1st STAGE EXTENDED	368" (30'-8") / 9.347 M
2nd , 1st STAGES & MANUAL EXTENDED	474" (39'-6") / 12.039 M
1st STAGE STROKE	107" (8'-11") / 2.717 M
2nd STAGE STROKE	95" (7'-11") / 2.413 M
MANUAL CAPACITY / 4 LIFT HOUSINGS	700 TON / 635 METRIC TON
1st STAGE CAPACITY / 4 LIFT HOUSINGS	700 TON / 635 METRIC TON
2nd STAGE CAPACITY / 4 LIFT HOUSINGS	470 TON / 426 METRIC TON
WHEEL SPECIFICATION	9" (229 mm) DIA. x 4.5" (114 mm) WIDE
WHEEL QUANTITY	8 WHEELS PER LIFT HOUSING
WHEEL GUIDE ROD CENTERS	36" (914 mm)
WHEEL BASE (CENTER TO CENTER)	93.5" (2,375 mm)
CONTROL MODULE WEIGHT	6500 LBS. / 2950 KG.
CONTROL MODULE POWER	KUBOTA DIESEL ENGINE
ENGINE SPECIFICATIONS	68 HORSE POWER
TWO SPEED SHIFTING SYSTEM	1100 TO 1200 PSI
HYDRAULIC RESERVOIR CAPACITY	400 GAL. / 1514 L

[1](PER J&R, THE EXTENDED WEIGHT ACCOUNTS FOR 77 GALLONS OF HYDRAULIC OIL IN THE LIFT CYLINDER AT FULL EXTENSION



NOTES:

1. ONLY HIGHLIGHTED KETTLES WILL BE HANDLED WITH THE BIGGE GANTRY SYSTEM.

2. GANTRY SIDE SHIFT SHALL BE USED TO REPOSITION RIGGING FOR THE DIFFERENT EAST/WEST KETTLE LOCATIONS BUT NOT TO MOVE KETTLES WHILE SUSPENDED.

3. ESTIMATED MAXIMUM STATIC BEARING PRESSURE UNDER TRACK = 4.5 KSF.

PARTIAL PLAN VIEW
KETTLE LIFT GENERAL ARRANGEMENT

REGISTERED PROFESSIONAL ENGINEER
DAMIAN C. GRONSKY
C73826
EXP. 6/30/17
CIVIL
STATE OF CALIFORNIA

Damian Gronsky
Date Signed: 12/06/2016
Digitally Signed by Damian Gronsky

NO.	REVISIONS	DRAWN DATE	DRAWN BY	CHECKED DATE	CHECKED BY	APPROVED DATE	APPROVED BY
1	LENGTHEN TRACK TO HANDLE KETTLE "G"	12/02/2016	MJA	12/02/2016	MJA	12/2/2016	OPH
0	ORIGINAL ISSUE	11/23/2016	MJA	11/23/2016	MJA	11/30/2016	OPH

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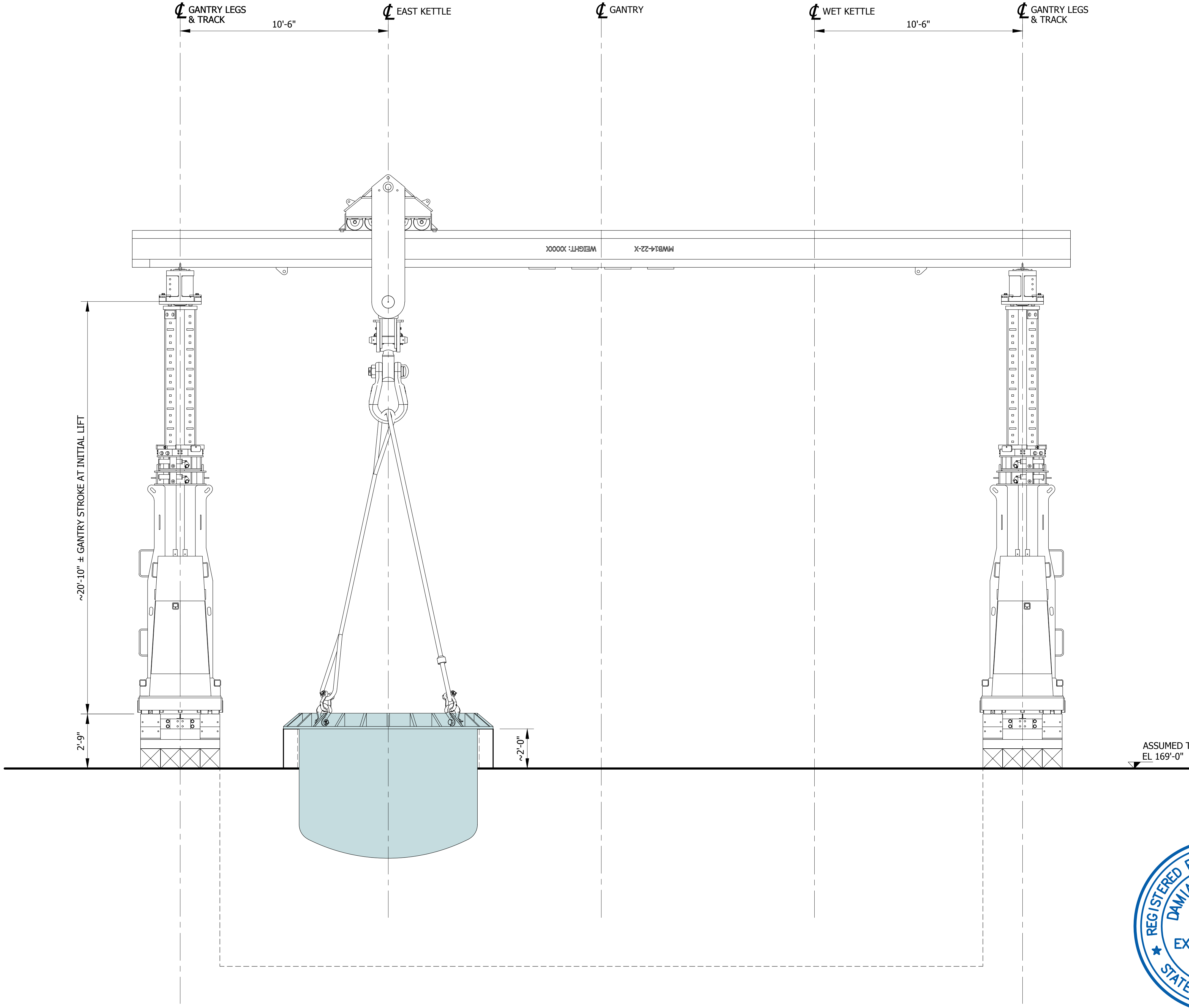
KETTLE LIFT GENERAL ARRANGEMENT
PARTIAL PLAN VIEW
EXIDE KETTLE REMOVAL
AMERICAN INTEGRATED SERVICES

SCALE: (U.N.O)	SIZE	PROJECT No.	DWG. No.	SHEET	REV.
1"=20'-0"	B	10-04-032165	001	1 of 4	1



A 1|2 END ELEVATION - INITIAL LIFT POSITION

(EAST KETTLE HANDLING SHOWN, WEST KETTLE SIMILAR)

Date Signed: **12/06/2016**

Digitally Signed by Damian Gronsky

0	ORIGINAL ISSUE	11/23/2016	MJA	11/23/2016	MJA	11/30/2016	OPH
NO.	REVISIONS	DATE	BY	DATE	BY	DATE	BY
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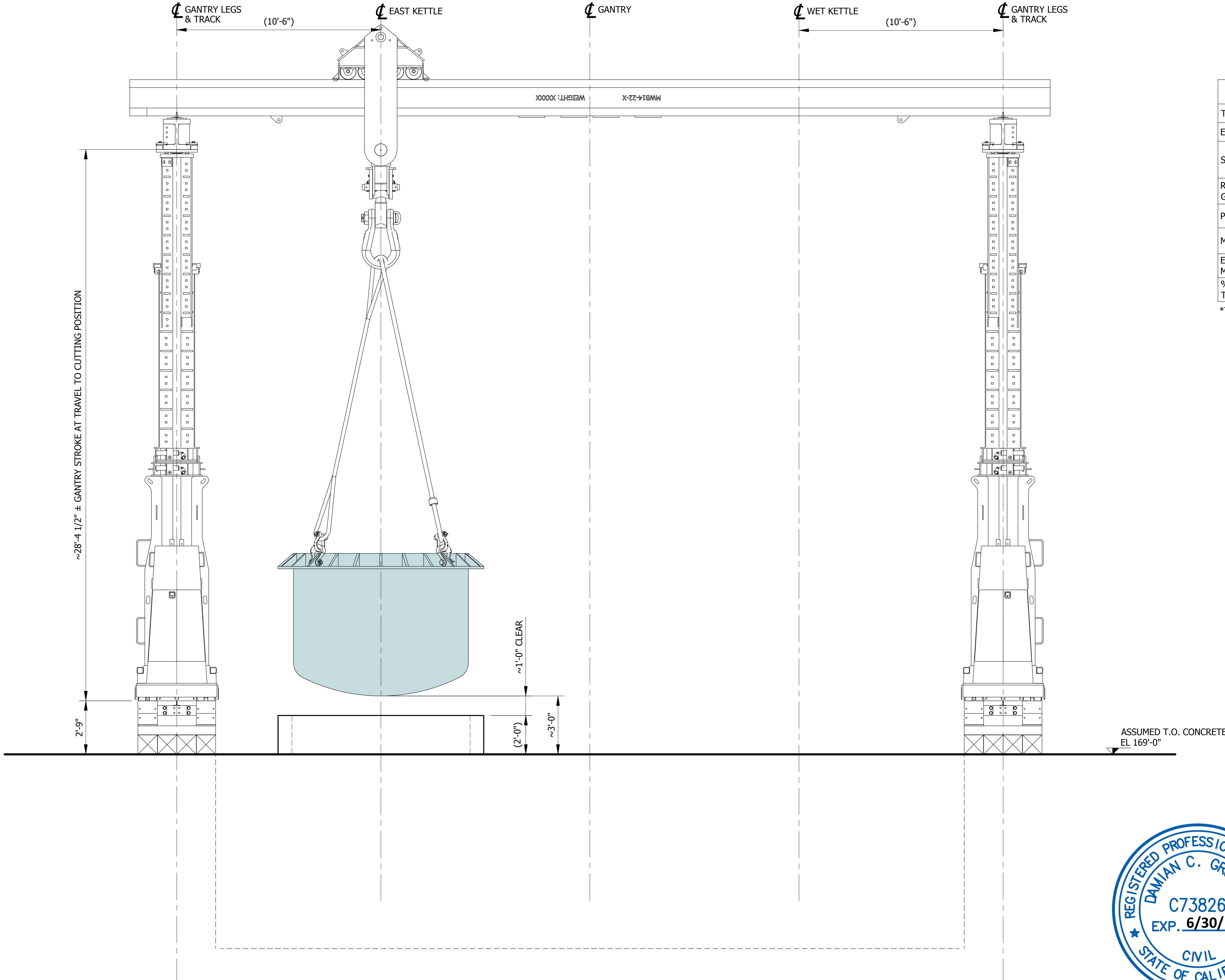
KETTLE LIFT GENERAL ARRANGEMENT
ELEVATION VIEW - INITIAL LIFT POSITION
EXIDE KETTLE REMOVAL
AMERICAN INTEGRATED SERVICES

SCALE: (U.N.O)	SIZE	PROJECT No.	DWG. No.	SHEET	REV.
3/16"=1'-0"	B	10-04-032165	001	2 of 4	1



GANTRY LIFT DATA		
TYPE:	J&R 1400 SERIES	
EXTENSION:	28'-4 1/2" (30'-7" MAX)	
STAGE AT EXTENSION:	2ND (WITHOUT MANUAL EXTENDED)	
RATED CAPACITY PER SINGLE GANTRY AT EXTENDED STAGE:	235,000	LBS
PRESSURE AT RATED CAPACITY:	3,000	PSI
MAX LOAD TO SINGLE GANTRY:	141,500	LBS
ESTIMATED MAX PRESSURE FOR MAX LOAD TO SINGLE GANTRY:	1,806	PSI
% CAPACITY FOR MAX LOAD TO SINGLE GANTRY:	60.2%	

*THIS DATA SHOWN IS FOR THE WORST CASE SINGLE GANTRY LOAD, WITHOUT IMPACT (WEST GANTRIES FOR 152T LIFT)

A
1 | 3

END ELEVATION - TRAVEL POSITION

(EAST KETTLE HANDLING SHOWN, WEST KETTLE SIMILAR)

REGISTERED PROFESSIONAL ENGINEER
DAMIAN C. GRONSKY
C73826
EXP. 6/30/17
CIVIL
STATE OF CALIFORNIA

Damian Gronsky

Date Signed: **12/06/2016**

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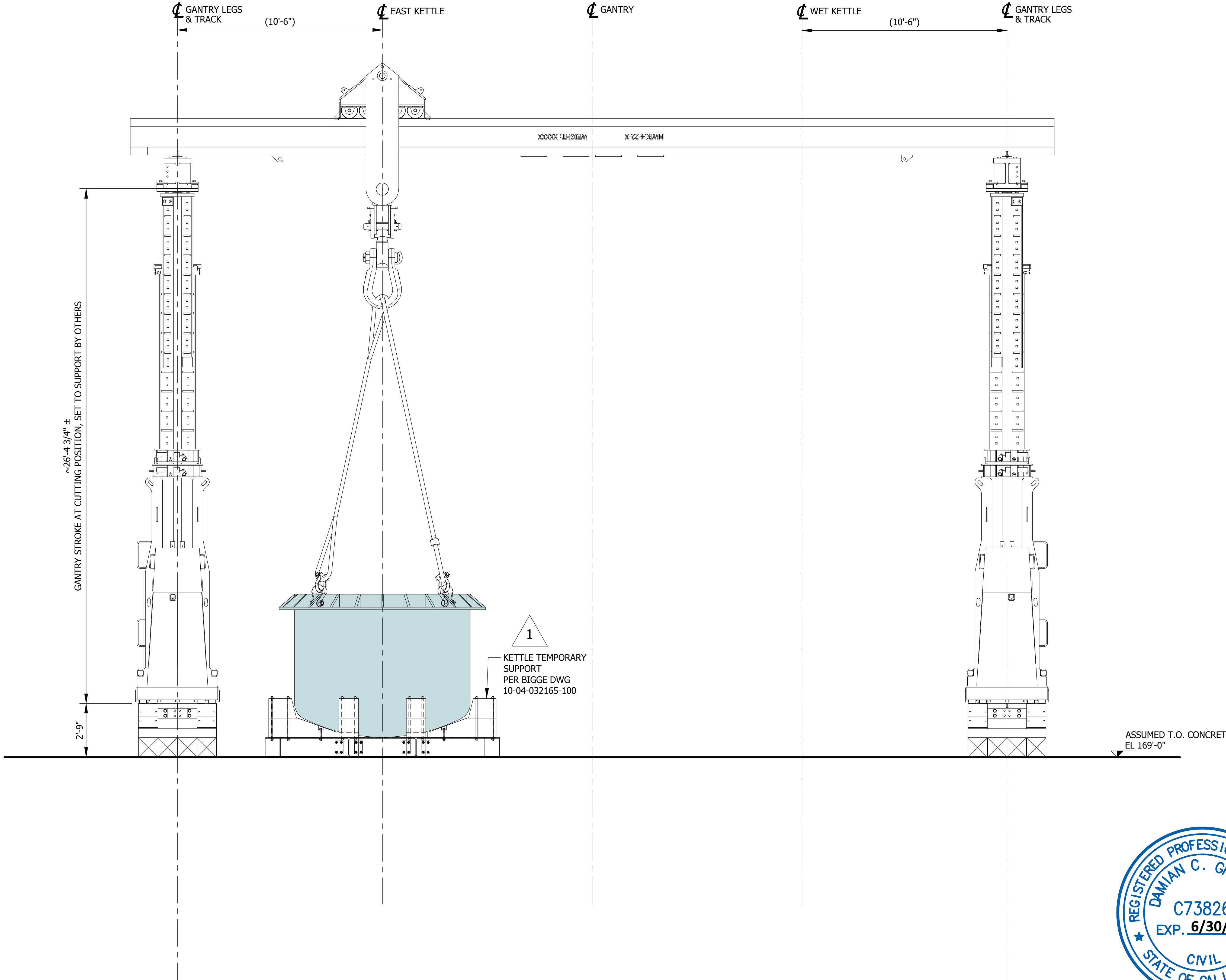
KETTLE LIFT GENERAL ARRANGEMENT
ELEVATION VIEW - TRAVEL POSITION
EXIDE KETTLE REMOVAL
AMERICAN INTEGRATED SERVICES

SCALE: (U.N.O)	SIZE	PROJECT No.	DWG. No.	SHEET	REV.
3/16"=1'-0"	B	10-04-032165	001	3 of 4	1



B
1 | 4

END ELEVATION - KETTLE DEMO AREA

(EAST KETTLE HANDLING SHOWN, WEST KETTLE SIMILAR)

REGISTERED PROFESSIONAL ENGINEER
DAMIAN C. GRONSKY
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EXP. 6/30/17
CIVIL
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Damian Gronsky
Date Signed: 12/06/2016
Digitally Signed by Damian Gronsky

NO.	REVISIONS	DRAWN DATE	DRAWN BY	CHECKED DATE	CHECKED BY	APPROVED DATE	APPROVED BY
1	REF. BIGGE PROVIDED KETTLE SUPPORTS	12/02/2016	MJA	12/02/2016	MJA	12/2/2016	OPH
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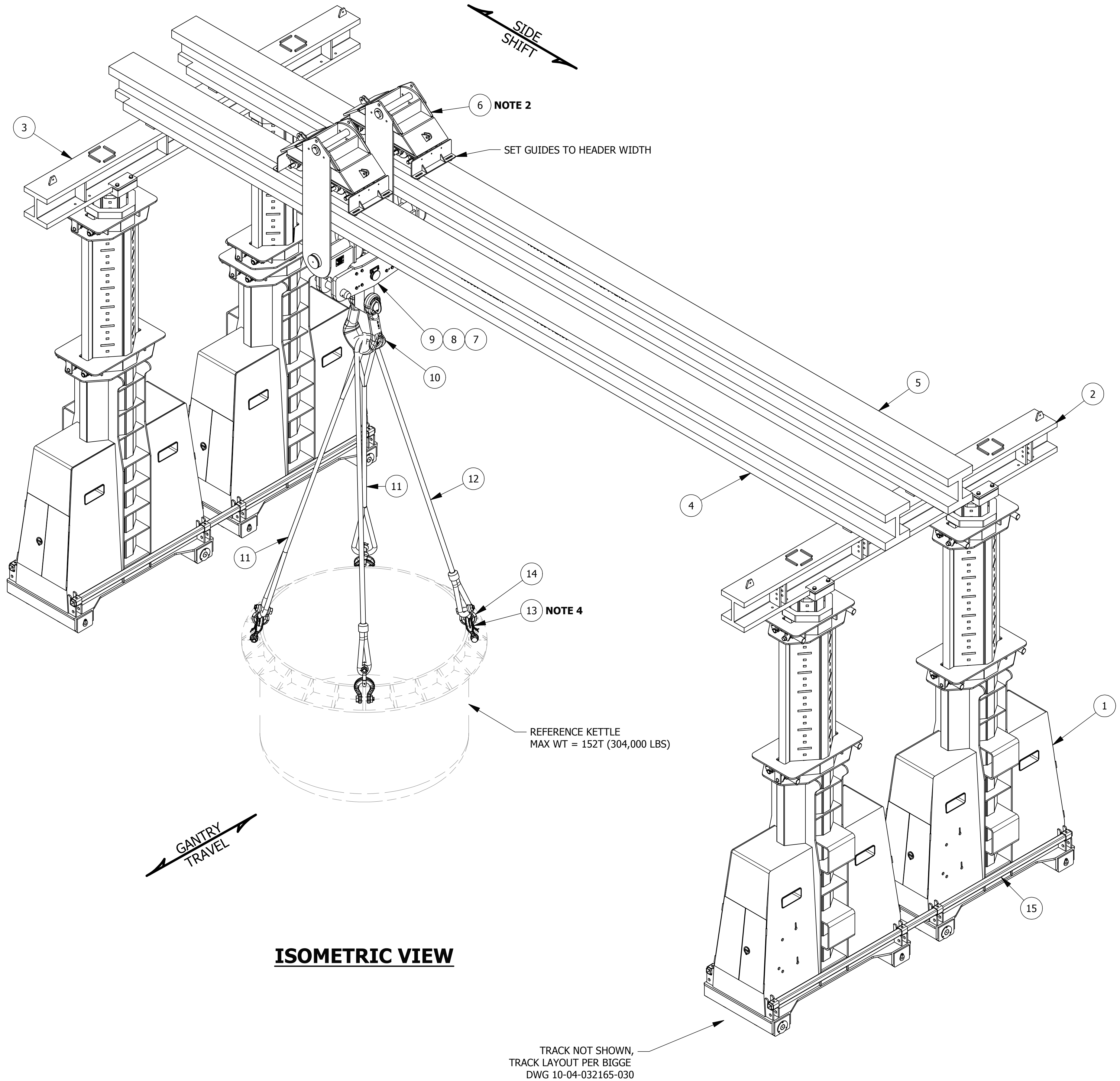
KETTLE LIFT GENERAL ARRANGEMENT
ELEVATION VIEW - KETTLE DEMO AREA
EXIDE KETTLE REMOVAL
AMERICAN INTEGRATED SERVICES

SCALE: (U.N.O)	SIZE	PROJECT No.	DWG. No.	SHEET	REV.
3/16"=1'-0"	B	10-04-032165	001	4 of 4	1



ISOMETRIC VIEW

PARTS LIST					
ITEM	QTY	PART No.	DESCRIPTION	WEIGHT EA (LBS)	WEIGHT TOTAL (LBS)
1	4	HG700	J&R 1400 SERIES HYDRAULIC GANTRY (700T CAP)	22300	89200
2	1	MWB14-15	MODIFIED W14x426 x 19'-1" (A992)	8471	8471
3	1	MWB14-14	MODIFIED W14x426 x 19'-1" (A992)	8471	8471
4	1	MWB14-22	MODIFIED W14x730 x 47'-4" (A992)	34545	34545
5	1	MWB14-23	MODIFIED W14x730 x 47'-4" (A992)	34547	34547
6	2		SIDE SHIFT - DRIVE - LIFT SYSTEMS 100T CAPACITY	2441	4882
7	2	RL90-17	90° LINK	411	822
8	2	RP4-4	Ø3.975" X 1'-11" RIGGING PIN	78	157
9	1	SB-187	250T SWIVEL SPREADER	1907	1907
10	1		300T CROSBY G-2160 WIDE BODY SHACKLE, OR EQ.	777	777
11	2		IWRC EIPS Ø2 1/4" X 15'-0", VERTICAL STRAIGHT SWL=44T, OR EQ.	220	440
12	1		IWRC EIPS Ø2 1/2" X 30'-0", VERTICAL BASKET SWL=109T, OR EQ.	500	500
13	4		40T CROSBY G-2160 WIDE BODY SHACKLE, OR EQ.	46	184
14	4		40T CROSBY G-2140 ALLOY BOLT TYPE SHACKLE, OR EQ.	34	135
15	4		HG700 TIE STRUT, ~18'-4" LONG, FOR 10'-0" GAUGE	162	647

TOTAL WT (LBS) = 185,685

NOTES:

1. ALL PINS SHALL HAVE SUITABLE KEEPERS.
2. REPLACE THE SIDE SHIFT SYSTEM LOAD HOLDER ATTACHMENT (BOTTOM LINK) WITH RL90-17 SO IT CAN CONNECT WITH SB187 (ITEM #9).
3. COMMON HEADER BEAM LOCATIONS ARE INTERCHANGEABLE, I.E. ITEMS #2 & 3, OR #4 & 5, CAN BE SWAPPED.
4. KETTLE RIGGING POINTS TO BE MODIFIED BY OTHERS AS NECESSARY TO FACILITATE THE INDICATED SHACKLE CONNECTION AND SAFE HANDLING OF THE KETTLES.

REGISTERED PROFESSIONAL ENGINEER
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EXP. 6/30/17
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STATE OF CALIFORNIA

Damian Gronsky
Date Signed: **12/06/2016**
Digitally Signed by Damian Gronsky

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GANTRY ASSEMBLY
ISOMETRIC VIEW & PARTS LIST
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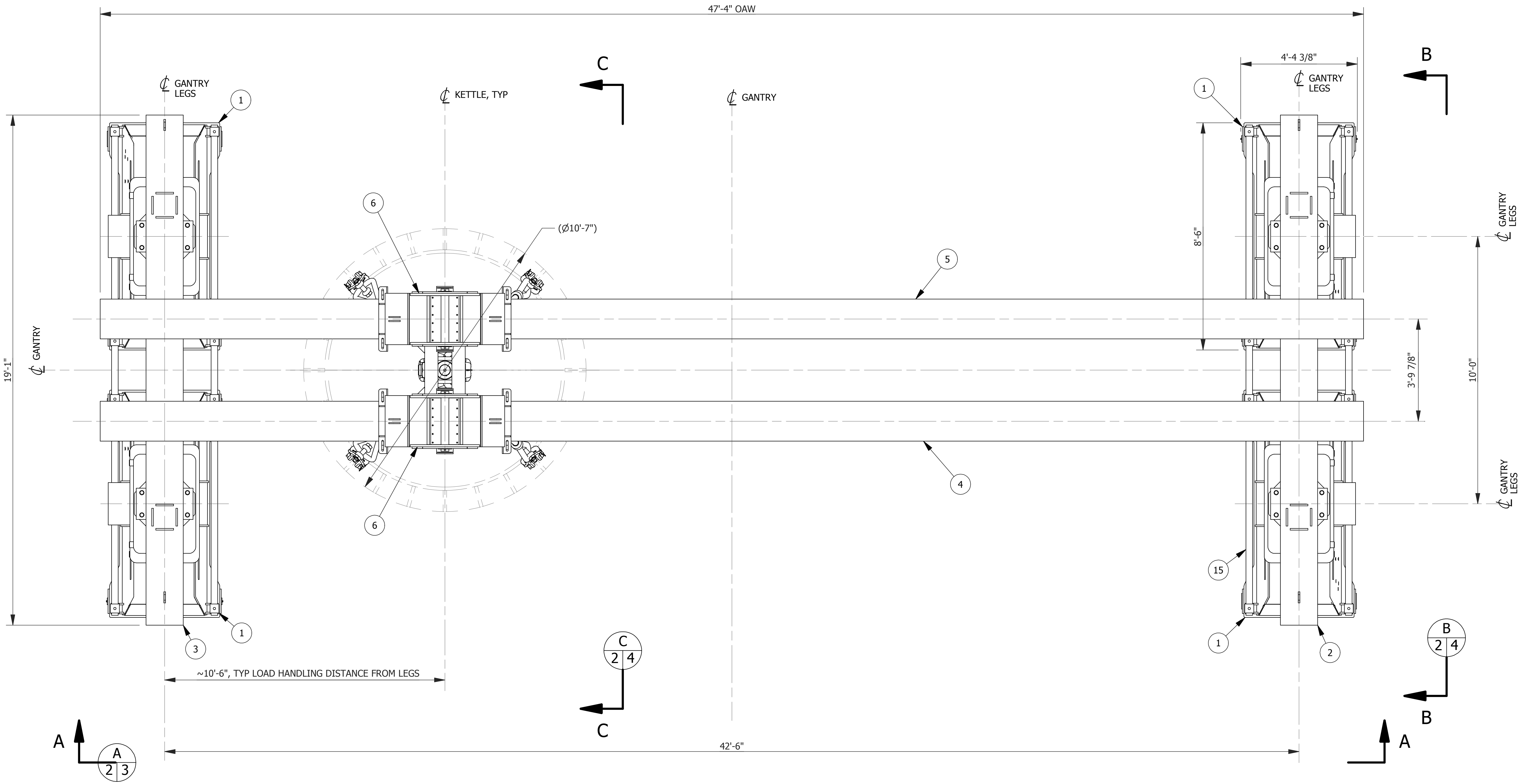
AMERICAN INTEGRATED SERVICES

SCALE: (U.N.O)	SIZE	PROJECT No.	DWG. No.	SHEET	REV.
NTS	B	10-04-032165	010	1 of 4	0



PLAN VIEW

REGISTERED PROFESSIONAL ENGINEER
DAMIAN C. GRONSKY
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EXP. 6/30/17
CIVIL
STATE OF CALIFORNIA

Date Signed: **12/06/2016**
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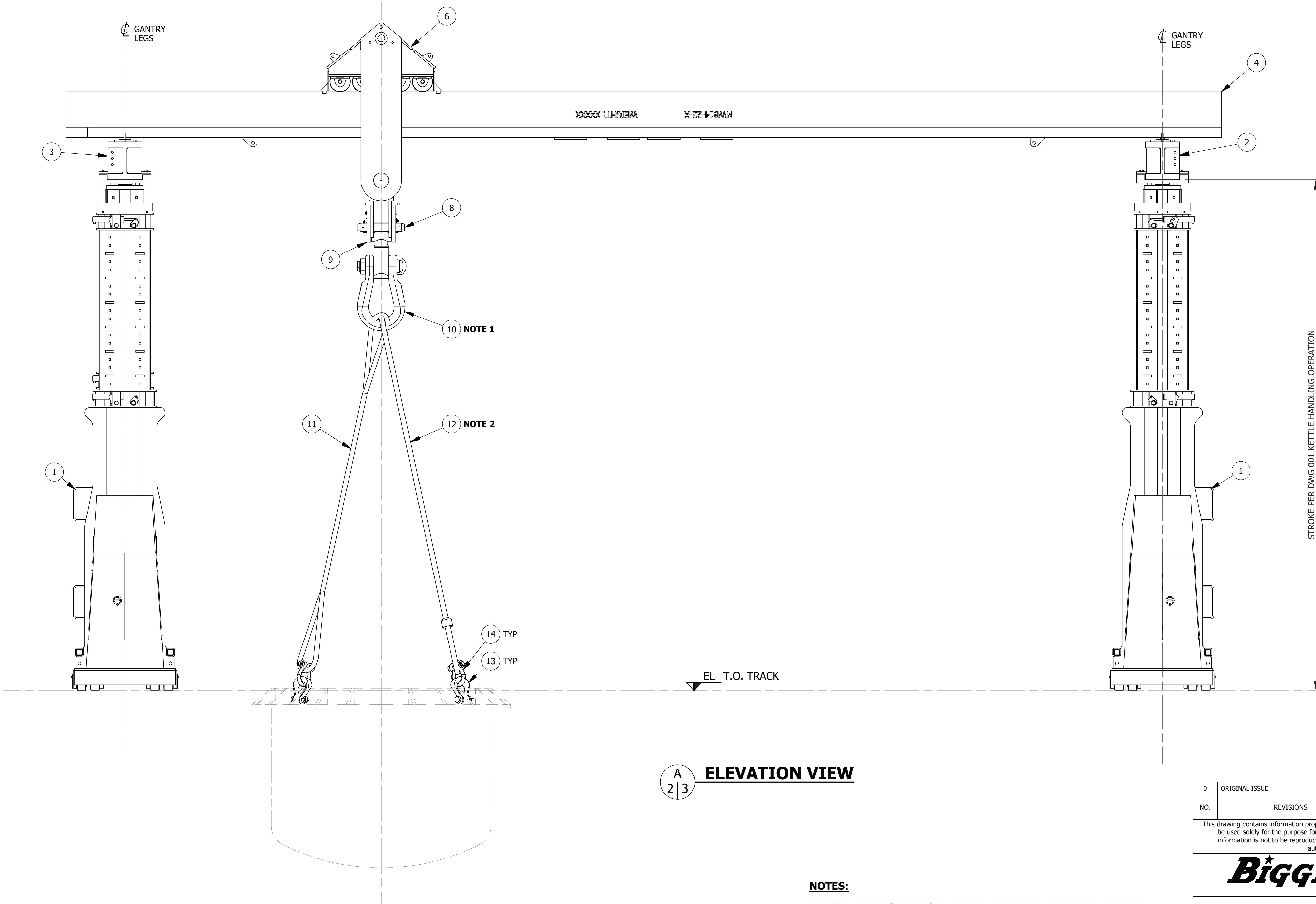
GANTRY ASSEMBLY
PLAN VIEW
EXIDE KETTLE REMOVAL
AMERICAN INTEGRATED SERVICES

SCALE: (U.N.O)	SIZE	PROJECT No.	DWG. No.	SHEET	REV.
1/4" = 1'-0"	B	10-04-032165	010	2 of 4	0



A 2 3 **ELEVATION VIEW**

REGISTERED PROFESSIONAL ENGINEER
DAMIAN C. GRONSKY
C73826
EXP. 6/30/17
CIVIL
STATE OF CALIFORNIA

Damian Gronsky
Date Signed: 12/06/2016
Digitally Signed by Damian Gronsky

NOTES:

1. ENSURE SHACKLE (ITEM #10) IS ORIENTED SO SLINGS ARE NOT TWISTED OR BOUND PRIOR TO LIFTING A KETTLE.

2. ITEM #12 (BASKET SLING) SHALL BE CONNECTED TO ADJACENT RIGGING POINTS ONLY (NOT OPPOSITE), TO PROVIDE A STABLE 3-POINT LIFT SYSTEM.

NO.	REVISIONS	DATE	BY	DATE	BY	DATE	BY
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		DRAWN		CHECKED		APPROVED	

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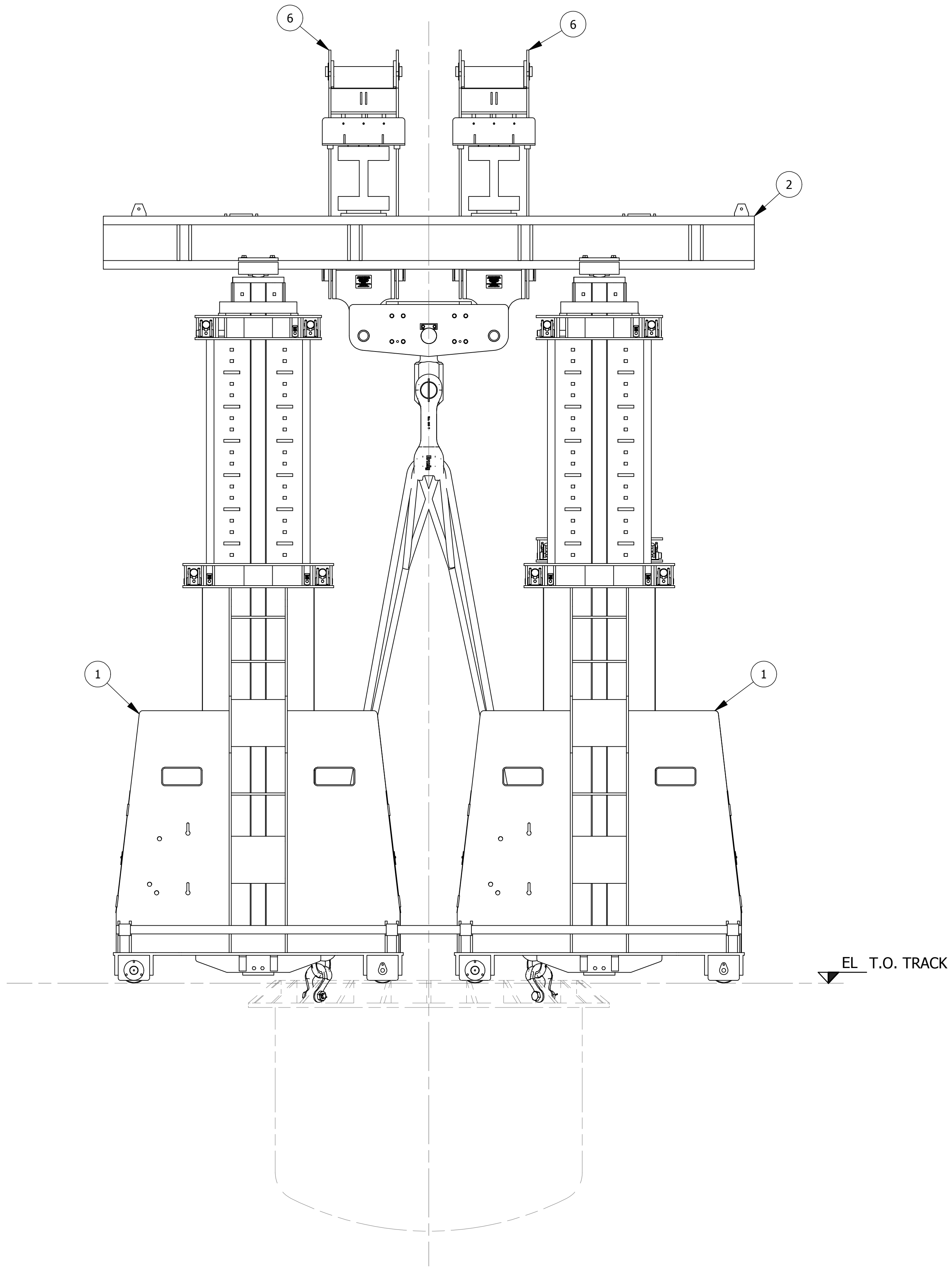
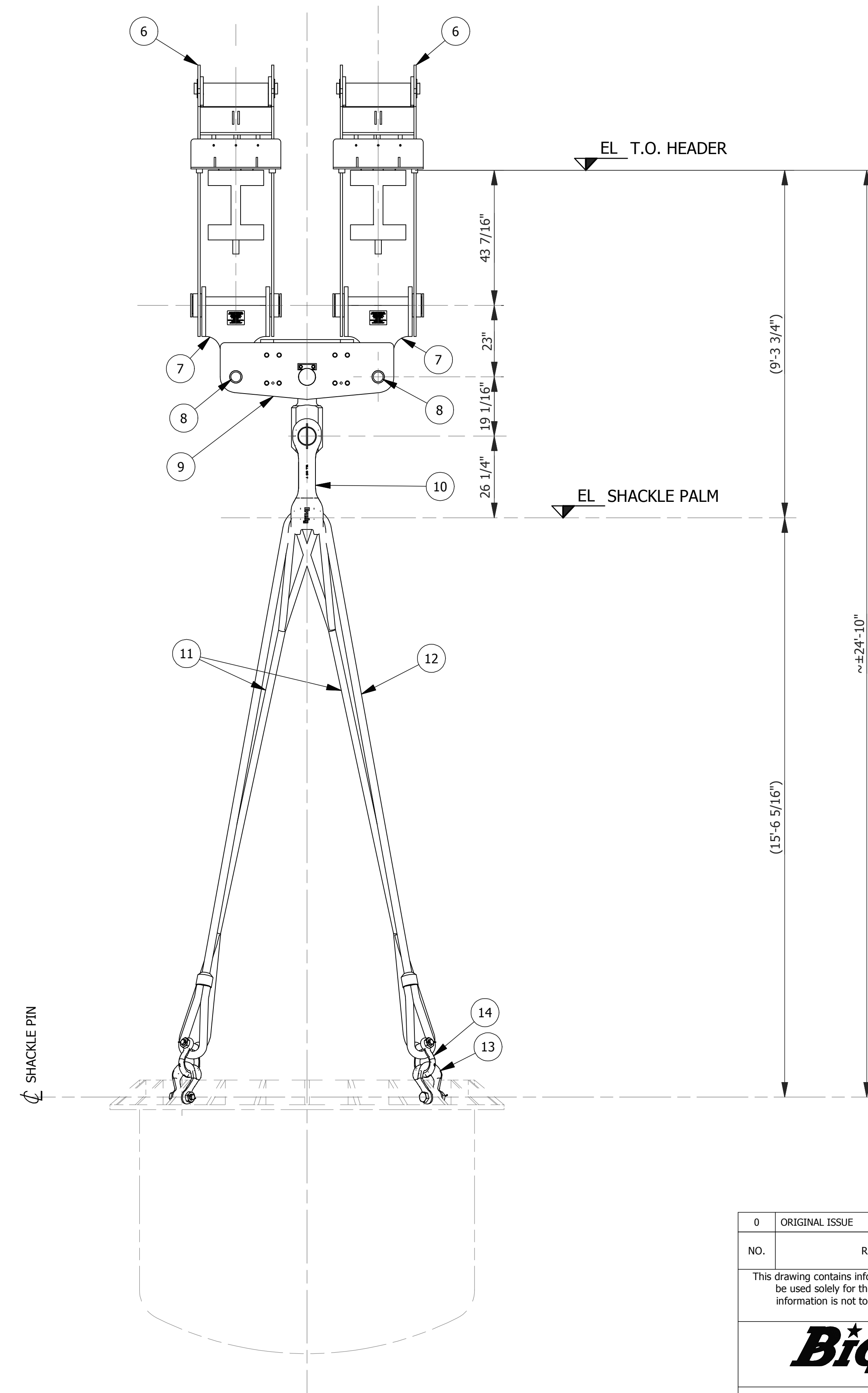
GANTRY ASSEMBLY
ELEVATION VIEW
EXIDE KETTLE REMOVAL
AMERICAN INTEGRATED SERVICES

SCALE: (U.N.O)	SIZE	PROJECT No.	DWG. No.	SHEET	REV.
1/4" = 1'-0"	B	10-04-032165	010	3 of 4	0



B
2 | 4

END ELEVATION



C
2 | 4

END ELEVATION

TYP KETTLE RIGGING

REGISTERED PROFESSIONAL ENGINEER
DAMIAN C. GRONSKY
C73826
EXP. 6/30/17
CIVIL
STATE OF CALIFORNIA

Date Signed: 12/06/2016
Digitally Signed by Damian Gronsky

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GANTRY ASSEMBLY
END ELEVATIONS
EXIDE KETTLE REMOVAL
AMERICAN INTEGRATED SERVICES

SCALE: (U.N.O)	SIZE	PROJECT No.	DWG. No.	SHEET	REV.
1/4"=1'-0"	B	10-04-032165	010	4 of 4	0

NOTES:

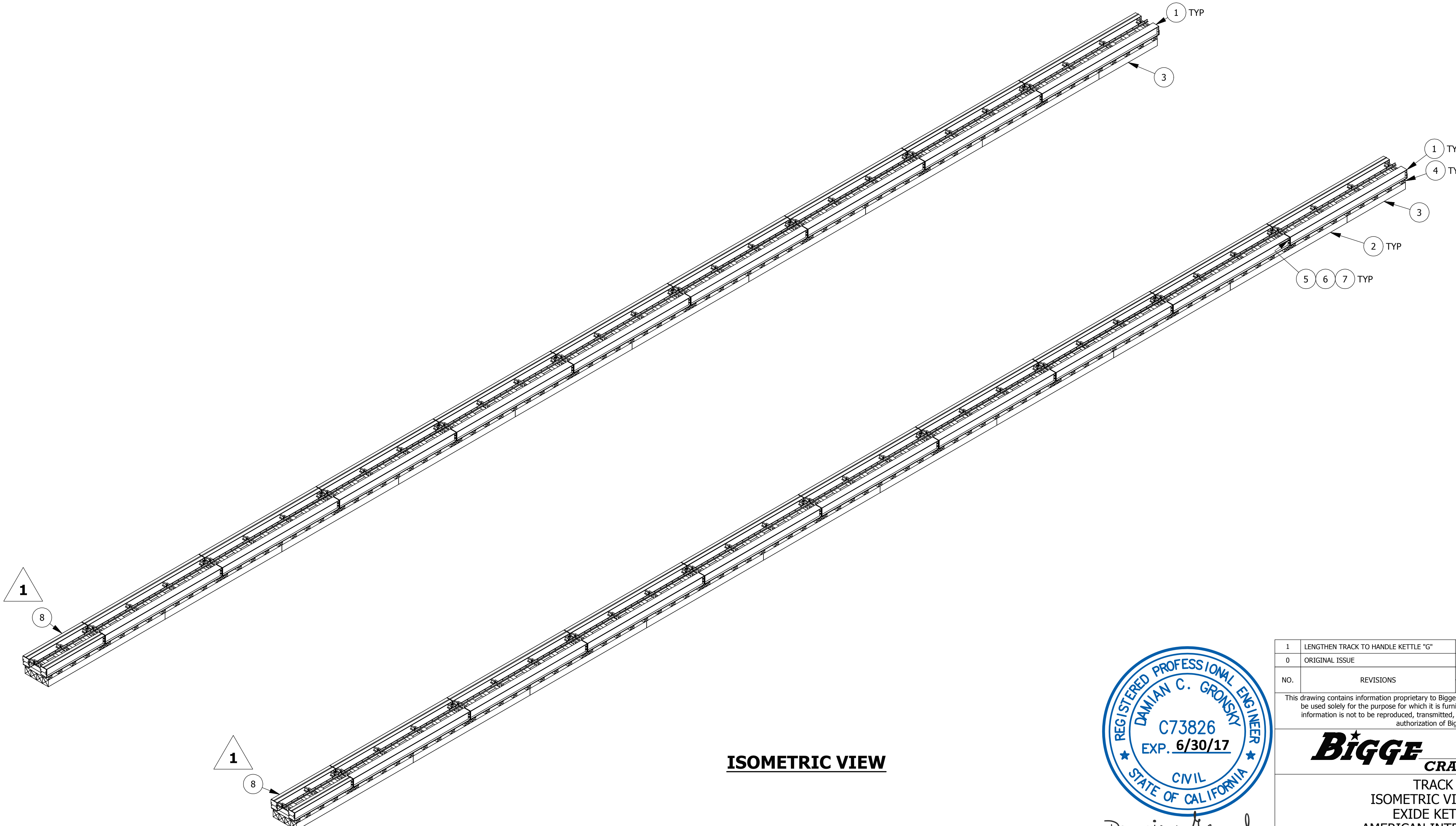
1. ALTERNATE GANTRY TRACK AND TIMBER MAT LENGTHS MAY BE USED AS NECESSARY TO ADDRESS FIELD CONDITIONS.
2. INDICATED FLOOR ELEVATIONS ARE BASED ON ORIGINAL BUILDING PLANS AND DO NOT INDICATE SLOPE OR OTHER FEATURES THAT WILL LIKELY NEED TO BE ADDRESSED. A SURVEY OF THE EXISTING FLOOR CONDITIONS SHOULD BE OBTAINED PRIOR TO RUNWAY INSTALLATION TO CONFIRM ACTUAL ELEVATIONS AND CRIBBING REQUIREMENTS.

1

PARTS LIST

ITEM	QTY	PART No.	DESCRIPTION	WEIGHT EA (LBS)	WEIGHT TOTAL (LBS)
1	18	HGR-3	HYDRAULIC GANTRY TRACK, 20'-0"	5153	92761
2	18		4' x 20' x 12" TIMBER MAT	3200	57600
3	2		4' x 10' x 12" TIMBER MAT	1600	3200
4	190		TIMBER, 6" x 8" x 48"	46	8708
5	144		HEX HEAD CAP SCREW, 3/4"-10 UNC x 3.5", SAE J429 GRADE 5, ZINC COATED	1	84
6	288		WASHER, 3/4", SAE THRU HARDENED, ZINC COATED	0	13
7	144		HEX NUT, 3/4"-10 UNC, SAE J995 GRADE 5, ZINC COATED	0	20
8	2	HGR-1	HYDRAULIC GANTRY TRACK, 10'-0"	2741	5482

TOTAL WT (LBS) = 167,868



ISOMETRIC VIEW

REGISTERED PROFESSIONAL ENGINEER
DAMIAN C. GRONSKY
C73826
EXP. 6/30/17
CIVIL
STATE OF CALIFORNIA

Date Signed: **12/06/2016**
Digitally Signed by Damian Gronsky

NO.	REVISIONS	DATE	BY	DATE	BY	DATE	BY
1	LENGTHEN TRACK TO HANDLE KETTLE "G"	12/2/2016	MJA	12/2/2016	MJA	12/2/2016	OPH
0	ORIGINAL ISSUE	11/28/2016	MJA	11/28/2016	MJA	11/30/2016	OPH
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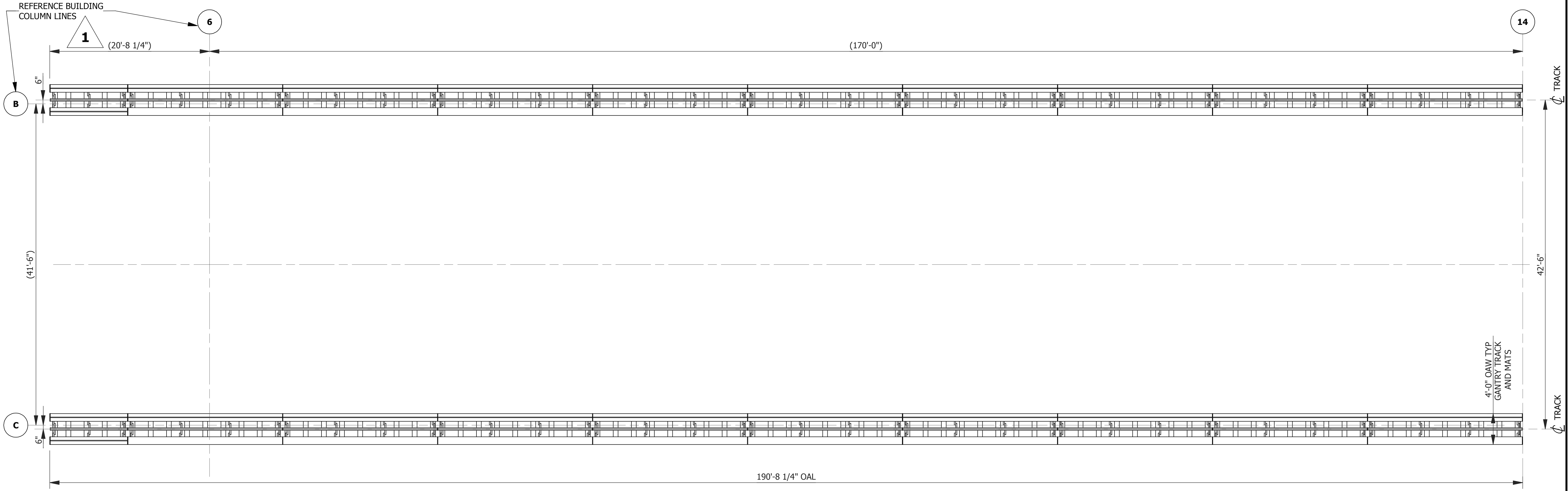
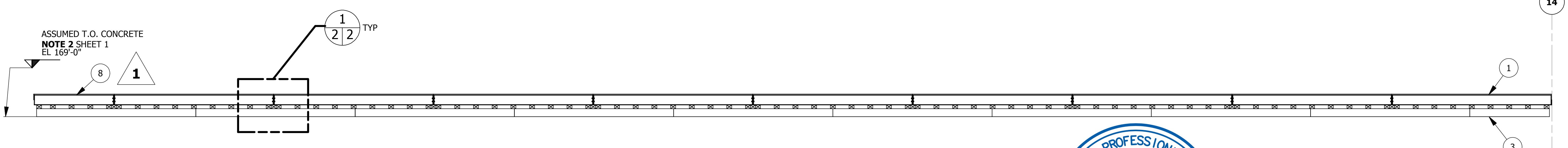
TRACK ASSEMBLY
ISOMETRIC VIEW & PARTS LIST
EXIDE KETTLE REMOVAL
AMERICAN INTEGRATED SERVICES

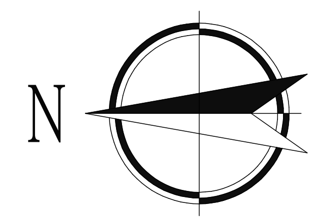
SCALE: (U.N.O)	SIZE	PROJECT No.	DWG. No.	SHEET	REV.
NTS	B	10-04-032165	030	1 of 2	1

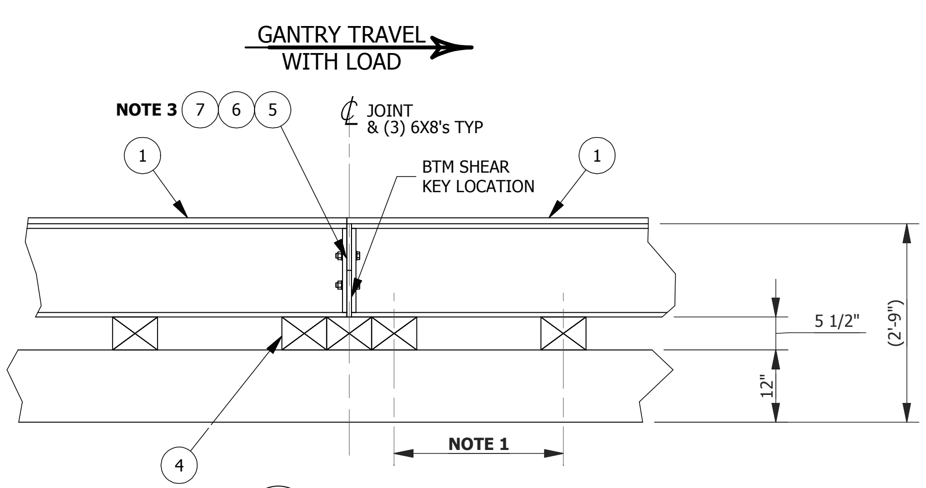


PLAN VIEW



ELEVATION VIEW





1 / 2 2 **DETAIL**
SCALE: 3/8" = 1'-0"

REGISTERED PROFESSIONAL ENGINEER
DAMIAN C. GRONSKY
C73826
EXP. 6/30/17
CIVIL
STATE OF CALIFORNIA

Damian Gronsky
Date Signed: 12/06/2016
Digitally Signed by Damian Gronsky

NOTES:

1. 6x8 TIMBERS (ITEM #4) SHALL BE ORIENTED WITH THE SHORT DIMENSION VERTICAL, AND A MAX. SPACING OF 2'-6" ON CENTER. (3) 6X8'S SHALL BE LOCATED AT EACH TRACK JOINT AS SHOWN. STAGGER TRACK AND MAT JOINTS 5'-0" MINIMUM.
2. PROVIDE ADDITIONAL CRIBBING AND SHIMS AS NECESSARY TO MAINTAIN A LEVEL TRACK PER SC&RA GUIDELINES. ENSURE CONTINUOUS CONTACT BETWEEN TRACK, 6X8'S, MATS, AND CONCRETE.
3. HARDWARE QUANTITIES MAY BE REDUCED BY 50% WITH A MINIMUM OF (2) BOLTS INSTALLED AT EACH INDIVIDUAL TRACK BOX BEAM CONNECTION.

NO.	REVISIONS	DATE	BY	DATE	BY	DATE	BY
1	LENGTHEN TRACK TO HANDLE KETTLE "G"	12/2/2016	MJA	12/2/2016	MJA	12/2/2016	OPH
0	ORIGINAL ISSUE	11/28/2016	MJA	11/28/2016	MJA	11/30/2016	OPH
		DRAWN		CHECKED		APPROVED	

10700 Bigge Ave., San Leandro, CA 94577
www.BIGGE.com

BIGGE
Established 1916
CRANE and RIGGING CO.

TRACK ASSEMBLY
PLAN & ELEVATION VIEW
EXIDE KETTLE REMOVAL
AMERICAN INTEGRATED SERVICES

SCALE: (U.N.O)	SIZE	PROJECT No.	DWG. No.	SHEET	REV.
1/150	B	10-04-032165	030	2 of 2	1

BIGGE CRANE and RIGGING CO. Established 1916

Page No.:	1 of 39
Bigge Job No.:	10-06-032165
Calculation No.:	C1
Revision No.:	0

Project Title:	Exide Kettle Removal		
Calculation Title:	Gantry Analysis		
Prime Contractor:		Contractor Job No.:	
Customer:	American Integrated Services	Customer Ref. No.:	
Prepared by:	Mike Anderson	Date:	11/29/2016
Reviewed by*:	Trace Higgins	Date:	11/30/2016
Approved by:	Trace Higgins	Date:	11/30/2016

REVISION RECORD

Revision Description:		No.:	
Prepared by:		Date:	
Reviewed by*:		Date:	
Approved by:		Date:	
Revision Description:		No.:	
Prepared by:		Date:	
Reviewed by*:		Date:	
Approved by:		Date:	
Revision Description:		No.:	
Prepared by:		Date:	
Reviewed by*:		Date:	
Approved by:		Date:	

Additional Notes:	Engineer's Seal:

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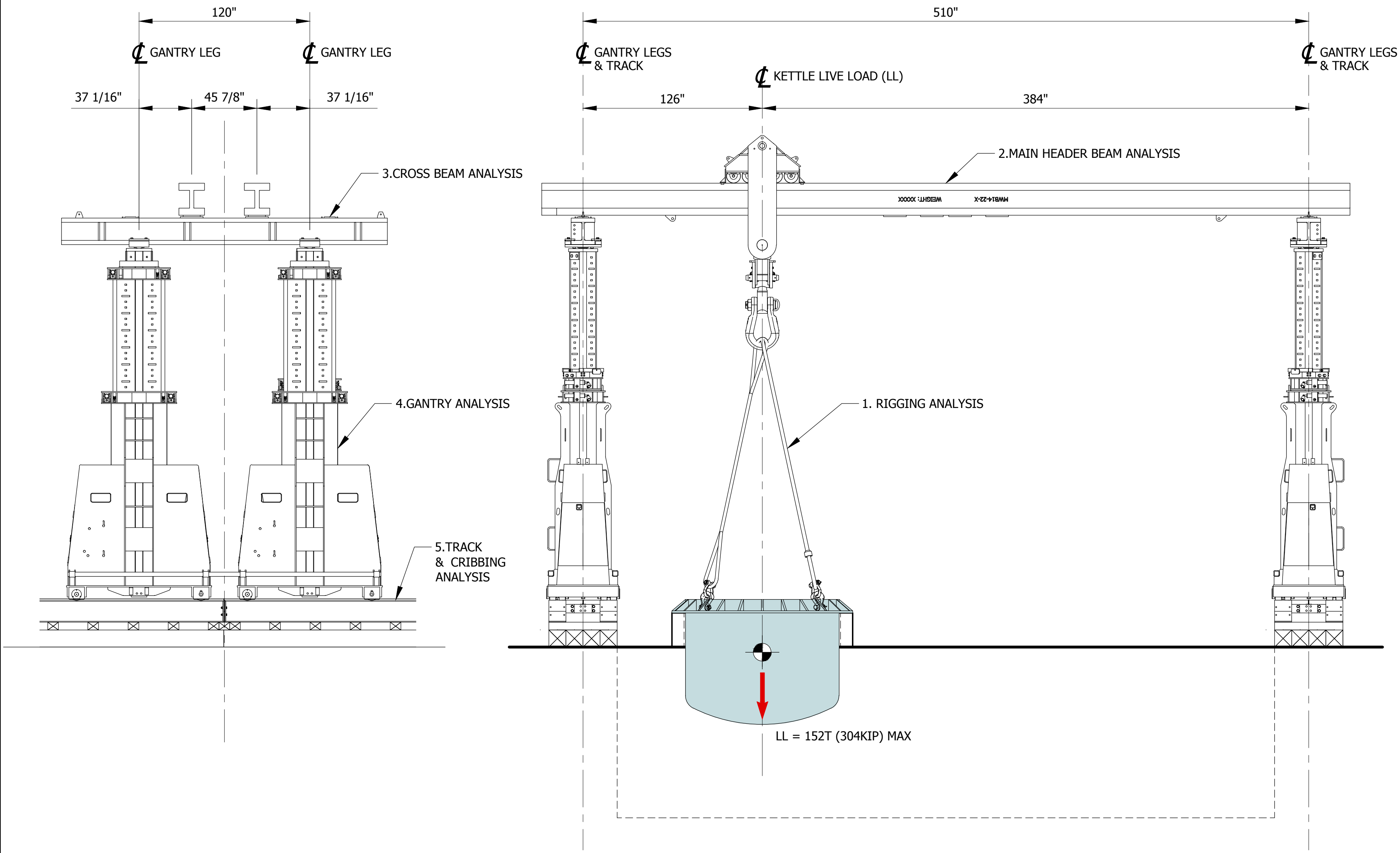
Damian Gronsky
Date Signed: 12/06/2016
Digitally Signed by Damian Gronsky

* Reviewer asserts this calculation is satisfactory by addressing where applicable: (a) correctness of design assumptions, design input, mathematics, computer programs, and output; and (b) suitability of specified materials, parts, processes, inspection and testing.

CONTENTS



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SUBJECT: GENERAL OUTLINE OF CALCULATION

FILE: 10-04-032165-C1

BY: MJA

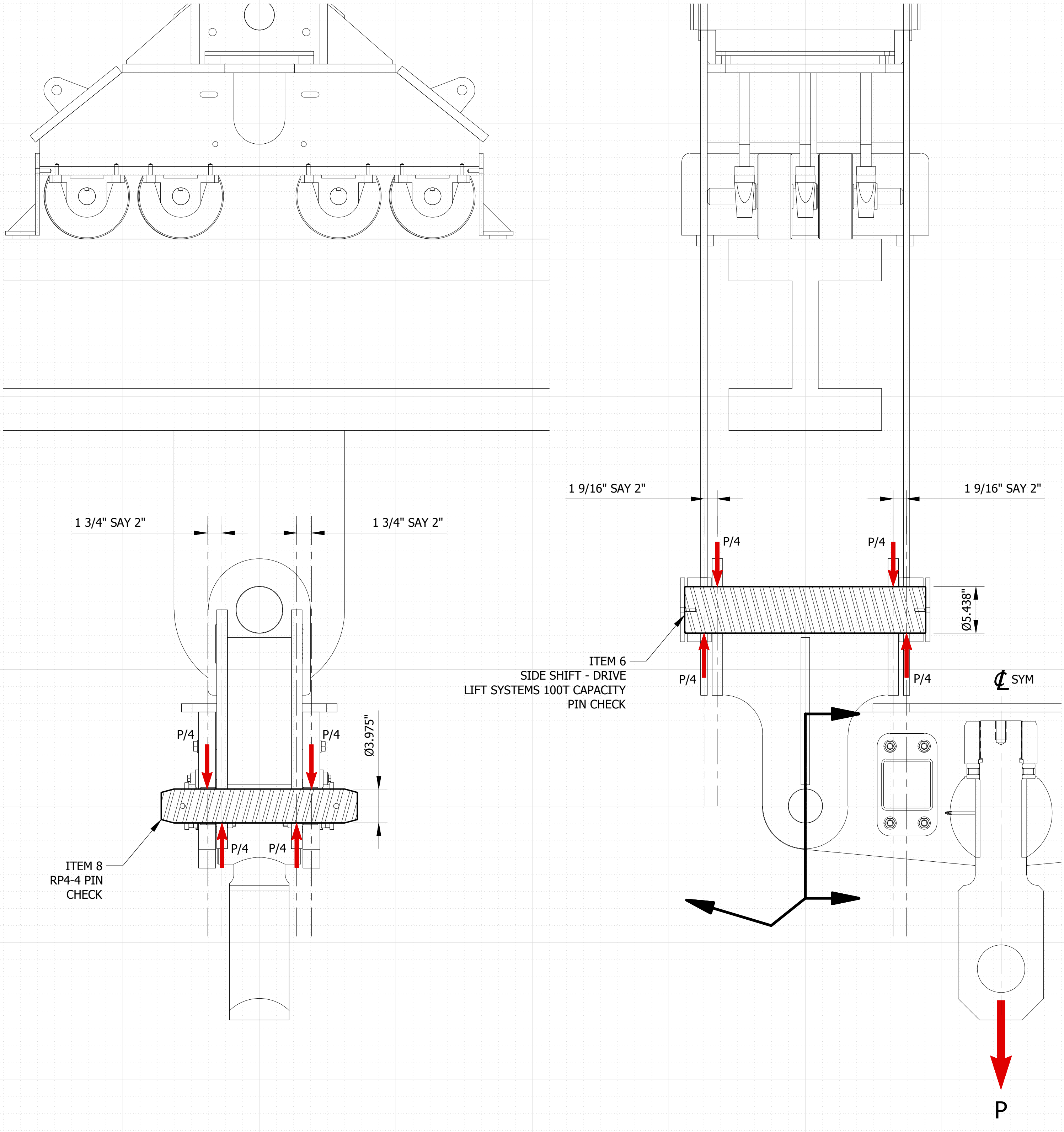
CHK/APP:

DATE: 11/30/16

SHEET: S.1

REVISION: 0

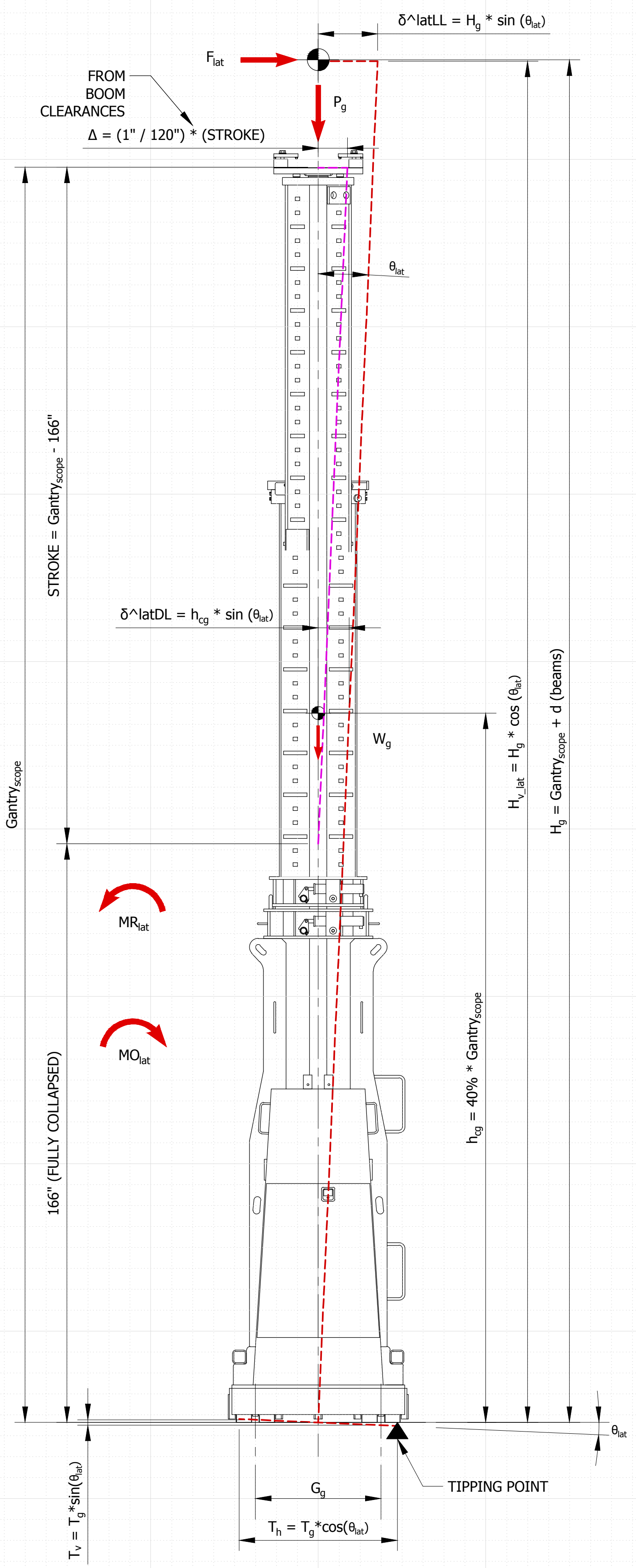
SCALE: 1/100



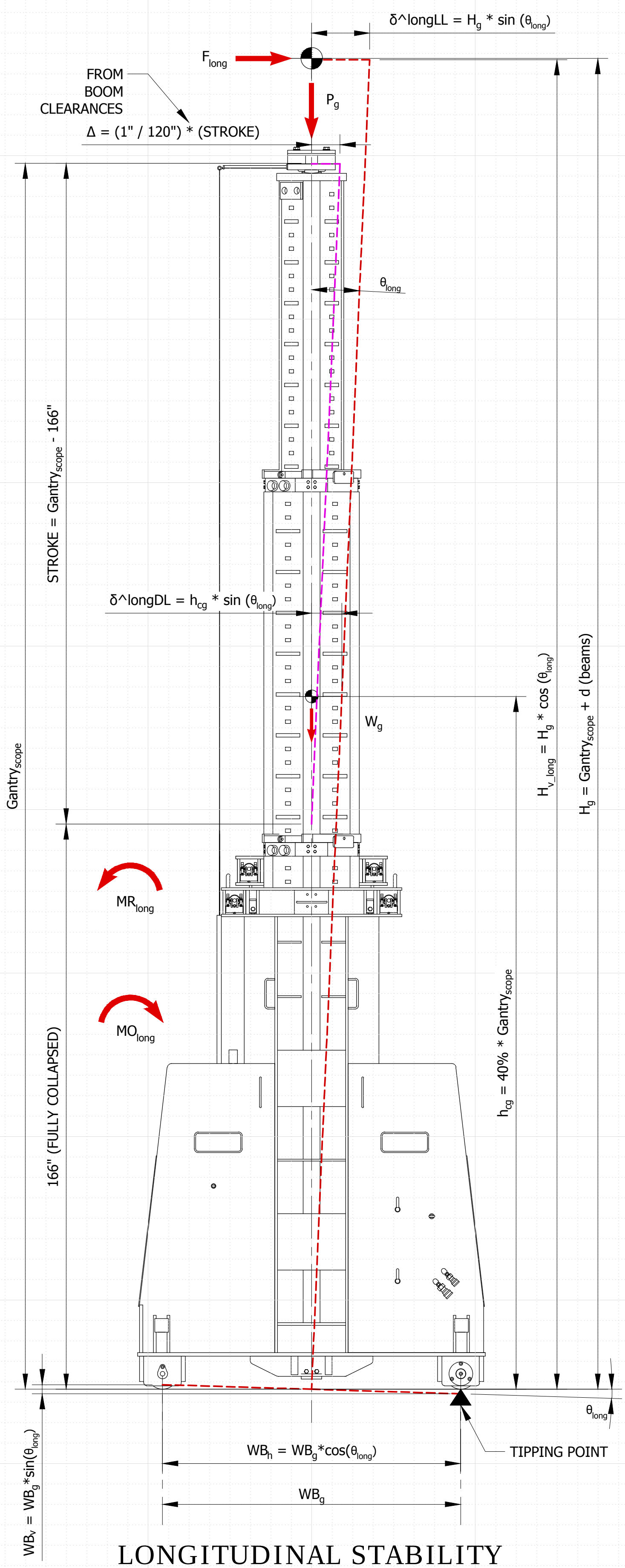
ITEM 8 & ITEM 6 PIN CHECKS

SCALE: 1/16

BIGGE CRANE and RIGGING CO. 10700 Bigge Ave., San Leandro, CA 94577 www.BIGGE.com Established 1916	SUBJECT: RIGGING PIN CHECKS				SHEET: S.2
	FILE: 10-04-032165-C1	BY: MJA	CHK/APP:	DATE: 11/30/16	REVISION: 0



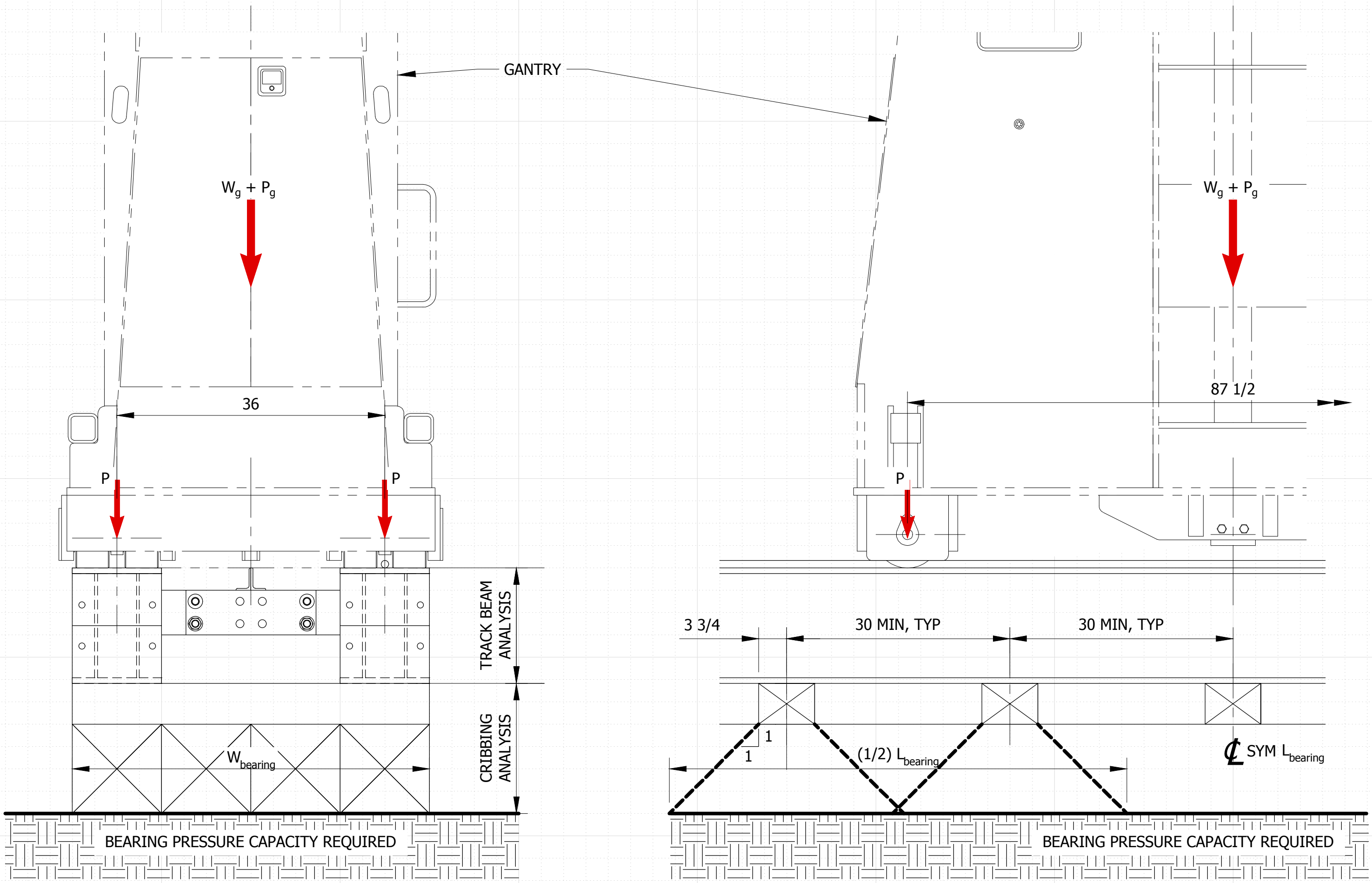
LATERAL STABILITY



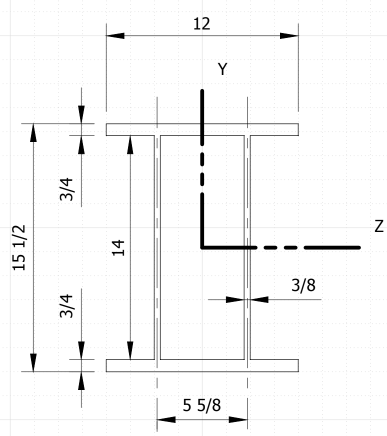
LONGITUDINAL STABILITY

SCALE: NTS

BIGGE CRANE and RIGGING CO. 10700 Bigge Ave., San Leandro, CA 94577 www.BIGGE.com Established 1916	SUBJECT: GANTRY STABILITY ANALYSIS - GENERAL PARAMETERS				SHEET: S.3
	FILE: 10-04-032165-C1	BY: MJA	CHK/APP:	DATE: 11/30/16	REVISION: 0



SCALE: 1/2"=1'-0"



SECTION PROPERTIES

A = 28.5 in^2
Iz = 1151.4 in^4
Iy = 299.2 in^4
Szmax =148.6 in^3
Szmin =148.6 in^3
Symax = 49.9 in^3
Symin = 49.9 in^3
Zz = 169.5 in^3
rz = 6.36 in
ry = 3.24 in

TRACK BEAM SECTION

SCALE: 1"=1'-0"

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SUBJECT: TRACK BEAM & CRIBBING ANALYSIS				SHEET: S.4
FILE: 10-04-032165-C1	BY: MJA	CHK/APP:	DATE: 11/30/16	REVISION: 0

Purpose and Scope

This calculation evaluates Bigge Crane and Rigging Company's hydraulic gantry system and rigging used for lifting and transfering Kettles for the Exide kettle removal project. For this particular project, a 700T Gantry System (HG700 (J&R 1400 Series)) will be used to transfer the components from their original position to the kettle demo area. This calculation will develop loads delivered to the hydraulic gantry system and rigging, then evaluate the system and rigging subject to that load.

Codes and Standards

Gantry Manufacturer Ratings: J&R 1400 Series Hydraulic Gantry (700T Capacity)

ASME B30.20 (Below the Hook Rigging Devices), B30.9 (Slings), B30.26 (Rigging Hardware)

ASME BTH-1, 2011 (Design of Below the Hook Rigging Devices)

AISC, Manual of Steel Construction, 13th Edition

References

Bigge Drawings:

10-04-032165-001 Kettle Lift General Arrangement - Rev 0
10-04-032165-010 Gantry Assembly - Rev 0
10-04-032165-030 Track Assembly - Rev 0
& Associated Bigge Equipment Drawings

Customer Drawings:

V-D6-88 (Vernon - 100 Ton Kettle - Rev 1)
DC-210 - Rev 2 (with customer markups)
DC-211 - Rev 3 (with customer markups)

Load Factors

Lift_Type := "dynamic" ;For setting Dynamic Force Variables based on lifting condition
"static" = lift and set condition
"dynamic" = lift roll and set condition

$I := 110\%$;Vertical Impact Load Factors

$H_{transv} = 5.0 \cdot \%$;Horizontal Misalignment Load (perpendicular to travel)

$H_{long} = 10.0 \cdot \%$;Longitudinal Load Factor (parallel to travel)

Wind Loads

Wind loads on the gantry system structural components are relatively small and considered insignificant compared to other loads. General industry practice considers the exclusion of wind loads from the evaluation to be appropriate as the lifted loads are typically very heavy relative to the effective sail area and lifts are usually performed in wind speeds of 20 mph or less at heights of 40 ft or less.

Load Cases

1. I*LL + DL (vert) — Hoisting
2. I*LL + DL (vert) + H_{transv}*LL (horiz) — Hoisting + Traveling (transverse case)
3. I*LL + DL (vert) + H_{long}*LL (horiz) — Hoisting + Traveling (longitudinal case)

Applicable Constants

$E := 29000ksi$ $G := 11200ksi$ $kip = 1000 \cdot lbf$ $tonf = 2\,kip$ $tonnef = 2.2\,kip$ $g = 32.2 \cdot \frac{ft}{s^2}$ $T := 2000lbf$

1. RIGGING ANALYSIS

$Kettle_{WT\_max} := 304kip$ $Rigging_{WT} := 12kip$;rigging weight (DWG 010) includes items 6 thru 14 + allowance, conservatively added to Kettle weight in rigging analysis

$P := Kettle_{WT\_max} + Rigging_{WT} = 316.0kip$

$L_{sling} := 15ft + 7in + 9.03in = 196.0in$

$X_{dim} := 57in$;distance from shackle pin connection to kettle to cg, TYP

$\theta_h := acos\left(\frac{X_{dim}}{L_{sling}}\right) = 73.1 \cdot deg$;Angle of sling from horizontal, ~TYP each leg

$P_{sling} := \frac{P}{(4) \cdot sin(\theta_h)} = 82.6kip$;Max load to sling, due to rigging configuration all 4 legs share the load, include for sling fleet amplification

IWRC EIPS Ø2 1/4 X 15'-0" - (010) ITEM 11

$d := 2.25in$;Sling nominal diameter

$Nominal_{BS} := 247T = 494.0 \cdot kip$;Nominal breaking strength, EIPS rope

$\eta_{mech\_splice} := 90\%$;Mechanical Splice Effeciency

$DF := 5$;Design Factor, 5:1 for slings

$P_{SLING\_SWL} := \frac{Nominal_{BS} \cdot \eta_{mech\_splice}}{DF} = 88.9 \cdot kip$ Capacity per sling leg $\boxed{\frac{P_{sling}}{P_{SLING\_SWL}} = 0.93}$

IWRC EIPS Ø2 1/2 X 30'-0" - (010) ITEM 12

$d := 2.50in$;Sling nominal diameter

$Nominal_{BS} := 302T = 604.0 \cdot kip$;Nominal breaking strength, EIPS rope

$\eta_{mech\_splice} := 90\%$;Mechanical Splice Effeciency

$DF := 5$;Design Factor, 5:1 for slings

$D := 12.26in$;break over 300T WB Shackle

$R_{D\_d} := \frac{D}{d} = 4.9$;WB break over to sling diameter ratio

$$\eta_{D\_d} := \begin{cases} \left[\left(100 - \frac{76}{R_{D\_d}^{0.73}}\right)\%\right] & \text{if } R_{D\_d} \geq 6.0 \\ \left[\left(100 - \frac{50}{\sqrt{R_{D\_d}}}\right)\%\right] & \text{otherwise} \end{cases} = 77.4 \cdot \%$$

;D/d reduction factor (body of sling over WB)

$P_{SLING\_SWL} := \frac{Nominal_{BS} \cdot min(\eta_{D\_d}, \eta_{mech\_splice})}{DF} = 93.5 \cdot kip$ Capacity per sling leg $\boxed{\frac{P_{sling}}{P_{SLING\_SWL}} = 0.88}$

40T SHACKLES - (010) ITEM 13 & ITEM 14

$Shackle_{40t\_cap} := 40tonnef = 88.2kip$ $\boxed{\frac{P_{sling}}{Shackle_{40t\_cap}} = 0.94}$

300T SHACKLE - (010) ITEM 10

$Shackle_{300t\_cap} := 300tonnef = 661.4kip$

$$\boxed{\frac{P}{Shackle_{300t\_cap}} = 0.48}$$

SB-187 250T SWIVEL SPREADER - (010) ITEM 9

$SB\_187_{250t\_cap} := 250T = 500.0kip$

$$\boxed{\frac{P}{SB\_187_{250t\_cap}} = 0.63}$$

RP4-4 PIN CHECK - (010) ITEM 8

$F_y := 90ksi \qquad F_u := 100ksi$

$D_p := 3.97in$

$N_d := 2.00$;Design Category A, Service Class 0

$V_{max} := \frac{P}{4} = 79.0kip \qquad M_{max} := V_{max} \cdot 2in = 158.0 \cdot kip \cdot in$;simple span max internal loads

CALCULATED PROPERTIES OF PIN

$A_g := \frac{\pi}{4} \cdot D_p^2 = 12.4 \cdot in^2 \qquad S := \frac{\pi}{32} \cdot D_p^3 = 6.14 \cdot in^3$

CALCULATED STRENGTHS

$f_b := \frac{M_{max}}{S} = 25.7 \cdot ksi \qquad F_b := \frac{1.25 \cdot F_y}{N_d} = 56.2 \cdot ksi \qquad \boxed{\frac{f_b}{F_b} = 0.46}$

$f_v := \frac{4}{3} \cdot \frac{V_{max}}{A_g} = 8.5 \cdot ksi \qquad F_v := \frac{F_y}{N_d \cdot \sqrt{3}} = 26.0 \cdot ksi \qquad \boxed{\frac{f_v}{F_v} = 0.33}$

RL90-17 100T 90° LINK - (010) ITEM 7 CHECK

$RL90\_17_{100t\_cap} := 100T = 200.0kip$

$$\boxed{\frac{\frac{P}{2}}{RL90\_17_{100t\_cap}} = 0.79}$$

SIDE SHIFT - DRIVE - LIFT SYSTEMS 100T CAPACITY - PIN CHECK - (010) ITEM 6

$F_y := 85ksi \qquad F_u := 100ksi$;ASTM A193 GRB16 HR&HT

$D_p := 5.438in$

$N_d := 2.00$;Design Category A, Service Class 0

$V_{max} := \frac{P}{4} = 79.0kip \qquad M_{max} := V_{max} \cdot 2in = 158.0 \cdot kip \cdot in$;simple span max internal loads

CALCULATED PROPERTIES OF PIN

$A_g := \frac{\pi}{4} \cdot D_p^2 = 23.2 \cdot in^2 \qquad S := \frac{\pi}{32} \cdot D_p^3 = 15.79 \cdot in^3$

CALCULATED STRENGTHS

$f_b := \frac{M_{max}}{S} = 10.0 \cdot ksi$ $\qquad F_b := \frac{1.25 \cdot F_y}{N_d} = 53.1 \cdot ksi$ $\qquad \boxed{\frac{f_b}{F_b} = 0.19}$

$f_v := \frac{4}{3} \cdot \frac{V_{max}}{A_g} = 4.5 \cdot ksi$ $\qquad F_v := \frac{F_y}{N_d \cdot \sqrt{3}} = 24.5 \cdot ksi$ $\qquad \boxed{\frac{f_v}{F_v} = 0.18}$

SIDE SHIFT - DRIVE - LIFT SYSTEMS 100T CAPACITY - GENERAL CHECK - (010) ITEM 6

$LIFT\_SYS\_SS_{100t\_cap} := 100T = 200.0 \, kip$ $\qquad \boxed{\frac{\frac{P}{2}}{LIFT\_SYS\_SS_{100t\_cap}} = 0.79}$

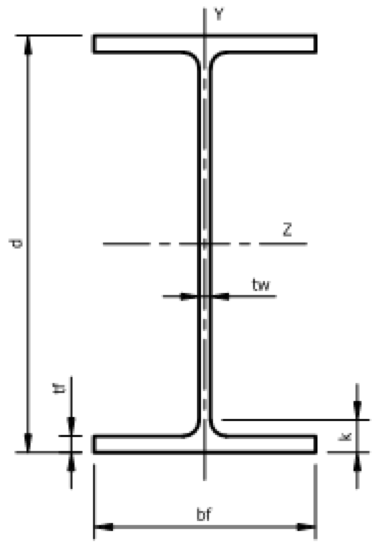
The indicated rigging is acceptable. Kettle rigging points to be modified by others as necessary to facilitate the indicated shackle connection and safe handling of the kettles per Bigge DWG 010.

2. Main Header Beam Analysis

MEMBER = "Main Header Beam" SHAPE = "W14X730" LOADCASE = "MAX DEVELOPED"

Section and Material Properties

$d = 22.40in$	$I_y = 4720.0 \cdot in^4$	$I_z = 14300.0 \cdot in^4$
$t_w = 3.07in$	$S_y = 527.0 \cdot in^3$	$S_z = 1280.0 \cdot in^3$
$b_f = 17.90in$	$r_y = 4.69in$	$r_z = 8.17in$
$t_f = 4.91in$	$Z_y = 816.0 \cdot in^3$	$Z_z = 1660.0 \cdot in^3$
$A_g = 215.0 \cdot in^2$	$J_x = 1450.0 \cdot in^4$	$r_{ts} = 5.68in$
$A_{vy} := d \cdot t_w = 68.8 \cdot in^2$	$k_{des} = 5.51in$	$C_w = 362000.0 \cdot in^6$
$A_{vz} := 2 \cdot b_f \cdot t_f = 175.8 \cdot in^2$	$h_0 = 17.49in$	$h = 11.38in$
$F_y := 50ksi$	$F_u := 65ksi$	$E = 29000.0 \cdot ksi$



Check Width-Thickness Ratios

CONFIRM ALL ELEMENTS OF THIS SECTION ARE COMPACT FOR BENDING AND SHEAR AND NON-NONSLENDER FOR COMPRESSION, USING AISC TABLE B4.1 OR AS NOTED:

$\lambda_{flange} = 1.82$

$\lambda_{web} = 3.71$

AISC Case 1 $\lambda_{p\_flange\_bend} := 0.38 \cdot \sqrt{E \div F_y} = 9.15$ $\quad is(\lambda_{flange} \le \lambda_{p_flange_bend}) = $ "Yes, OK"

AISC Case 3 $\lambda_{r\_flange\_compr} := 0.56 \cdot \sqrt{E \div F_y} = 13.49$ $\quad is(\lambda_{flange} \le \lambda_{r_flange_compr}) = $ "Yes, OK"

AISC Case 9 $\lambda_{p\_web\_bend} := 3.76 \cdot \sqrt{E \div F_y} = 90.55$ $\quad is(\lambda_{web} \le \lambda_{p_web_bend}) = $ "Yes, OK"

AISC Case 10 $\lambda_{r\_web\_compr} := 1.49 \cdot \sqrt{E \div F_y} = 35.88$ $\quad is(\lambda_{web} \le \lambda_{r_web_compr}) = $ "Yes, OK"

AISC G2.1a $\lambda_{web\_shear\_yield} := 2.24 \cdot \sqrt{E \div F_y} = 53.95$ $\quad is(\lambda_{web} \le \lambda_{web_shear_yield}) = $ "Yes, OK"

MEMBER = "Main Header Beam"   SHAPE = "W14X730"   LOADCASE = "MAX DEVELOPED"

Header Beam Internal Loads

$Span := 42.5ft = 510.0\,in$

$L_{HB} := 47.33ft$;length of header beam

$Wt_{HB} := 36kip$;weight allowance for header beam

$w_{HB} := \frac{Wt_{HB}}{L_{HB}} = 761 \cdot \frac{lbf}{ft}$;allowance of dist load for header beam

$Kettle_{WT\_max} = 304.0\,kip$

$Rigging_{WT} = 12.0\,kip$

$a := 384in$ $b := 126in$ $L_{span} := 510in$

$I = 110.0 \cdot \%$ $H_{transv} = 5.0 \cdot \%$ $H_{long} = 10.0 \cdot \%$

$$P_y := \frac{\left(Kettle_{WT\_max} + Rigging_{WT}\right) \cdot I}{2} = 173.8 \cdot kip$$

$$V_{ay} := P_y \cdot \left(\frac{a}{L_{span}}\right) + \frac{Wt_{HB}}{2} = 148.9 \cdot kip$$

$$M_{az} := V_{ay} \cdot b + \frac{w_{HB} \cdot Span^2}{8} = 20817.3 \cdot kip \cdot in$$

$$P_{ax} := \left(\frac{Kettle_{WT\_max} + Rigging_{WT}}{2}\right) \cdot H_{transv} = 7.9 \cdot kip$$

$$T_{ax} := 0kip \cdot in$$

$$V_{az} := \left(\frac{Kettle_{WT\_max} + Rigging_{WT}}{2}\right) \cdot \left(\frac{a}{L_{span}}\right) \cdot H_{long} = 11.9 \cdot kip$$

$$M_{ay} := V_{az} \cdot b = 1499.0 \cdot kip \cdot in$$

MEMBER = "Main Header Beam"   SHAPE = "W14X730"   LOADCASE = "MAX DEVELOPED"

Beam-Column Geometry

Stiffener := "no"   Bracing := "no"

$L_{span} = 510.0\,in$ $L_b := L_{span} = 510.0\,in$;Lb of span if stiffeners, or Lb of bracing if provided

$$L_{span} + \frac{d}{6}\cdot\left(\frac{t_f}{t_w}\right)^3 = 525.3\,in$$

$$L_b := \begin{cases} L_b & \text{if Stiffener = "yes"} \vee \text{Bracing = "yes"} \\ \left[L_{span} + \frac{d}{6}\cdot\left(\frac{t_f}{t_w}\right)^3\right] & \text{if Stiffener = "no"} \wedge \text{Bracing = "no"} \wedge \frac{d}{t_w} < 100 \wedge \frac{b_f}{d} < 1 \\ \text{"NG"} & \text{otherwise} \end{cases} = 525.3\,in$$

$L_b = 525.3\,in$ $C_b := 1$

$L_y := L_b = 525.3\,in$ $K_y := 1$

$L_z := L_b = 525.3\,in$ $K_z := 1$

$L_w := L_b = 525.3\,in$

Compression Design Strength (Pnx_Ω) - AISC E3

Slenderness Ratios

$K_y = 1.0$ $L_y = 525.3\,in$ $K_z = 1.0$ $L_z = 525.3\,in$

$$\Psi_y := \frac{K_y\cdot L_y}{r_y} = 112.0 \qquad \Psi_z := \frac{K_z\cdot L_z}{r_z} = 64.3 \qquad \Psi := \max(\Psi_z, \Psi_y) = 112.0$$

$$\Psi_r := 4.71\cdot\sqrt{\frac{E}{F_y}} = 113.4$$

Strength

$\Omega_c := 1.67$

$$F_e := \frac{\pi^2\cdot E}{\Psi^2} = 22.8\cdot ksi \qquad F_{cr} := \begin{cases} \left(0.658^{\frac{F_y}{F_e}}\right)\cdot F_y & \text{if } \Psi \le \Psi_r \\ 0.877\cdot F_e & \text{otherwise} \end{cases} = 20\cdot ksi \qquad A_g = 215.0\cdot in^2$$

$$\boxed{P_{nx\_\Omega} := \frac{F_{cr}\cdot A_g}{\Omega_c} = 2573\,kip}$$

MEMBER = "Main Header Beam"   SHAPE = "W14X730"   LOADCASE = "MAX DEVELOPED"

Shear Strength Web (Vny_Ω) - AISC CHAPTER G

$E = 29000.0 \cdot ksi$ $F_y = 50.0 \cdot ksi$

$h = 11.4in$ $t_w = 3.1in$

$\lambda_{web} = 3.7$ $A_{vy} = 68.8 \cdot in^2$

transverse_stiffeners := "no"   ;either "no" or "yes"

$a := 1in$;transverse stiffener spacing

$$k_v := \begin{array}{|l} k_v \leftarrow 5 \ \text{ if transverse\_stiffeners = "no"} \wedge \lambda_{web} < 260 \\ k_v \leftarrow 5 + \dfrac{5}{\left(\dfrac{a}{h}\right)^2} \ \text{ if transverse\_stiffeners = "yes"} \\ k_v \leftarrow 5 \ \text{ if transverse\_stiffeners = "yes"} \wedge \left[\dfrac{a}{h} > 3.0 \vee \dfrac{a}{h} > \left[\dfrac{260}{\left(\dfrac{h}{t_w}\right)}\right]^2\right] \\ k_v \leftarrow \text{"Web too Slender, Redesign"} \ \text{ if } \lambda_{web} \geq 260 \\ \text{return } k_v \end{array} = 5.0$$

$$C_{vy} := \begin{array}{|l} C_v \leftarrow 1.0 \ \text{ if } \lambda_{web} \leq 2.24 \cdot \sqrt{\dfrac{E}{F_y}} \\ C_v \leftarrow 1.0 \ \text{ if } \lambda_{web} \leq 1.10 \cdot \sqrt{\dfrac{k_v \cdot E}{F_y}} \\ C_v \leftarrow \dfrac{1.10 \cdot \sqrt{\dfrac{k_v \cdot E}{F_y}}}{\lambda_{web}} \ \text{ if } 1.10 \cdot \sqrt{\dfrac{k_v \cdot E}{F_y}} < \lambda_{web} \leq 1.37 \cdot \sqrt{\dfrac{k_v \cdot E}{F_y}} \\ C_v \leftarrow \dfrac{1.51 \cdot E \cdot k_v}{\lambda_{web}^2 \cdot F_y} \ \text{ if } \lambda_{web} > 1.37 \cdot \sqrt{\dfrac{k_v \cdot E}{F_y}} \\ \text{return } C_v \end{array} = 1.0$$

$V_{ny} := 0.6 \cdot F_y \cdot A_{vy} \cdot C_{vy} = 2063.0kip$

Strength

$$\Omega_v := \begin{array}{|l} \Omega_v \leftarrow 1.50 \ \text{ if } \lambda_{web} \leq 2.24 \cdot \sqrt{\dfrac{E}{F_y}} \\ \Omega_v \leftarrow 1.67 \ \text{ if } \lambda_{web} > 2.24 \cdot \sqrt{\dfrac{E}{F_y}} \end{array} = 1.5$$

$$\boxed{V_{ny\_\Omega} := \frac{V_{ny}}{\Omega_v} = 1375 \cdot kip}$$

MEMBER = "Main Header Beam" SHAPE = "W14X730" LOADCASE = "MAX DEVELOPED"

Shear Strength - Flanges (Vnz_Ω) - AISC SECTION G7

$\Omega_{vz} := 1.67$ $A_{vz} = 175.8 \cdot in^2$ $F_y = 50.0 \cdot ksi$

$C_{vz} := 1.0$

$V_{nz} := (0.6 \cdot F_y) \cdot A_{vz} \cdot C_{vz} = 5273 kip$

$$\boxed{V_{nz\_\Omega} := \frac{V_{nz}}{\Omega_{vz}} = 3158 \cdot kip}$$

Bending Strength - Strong Axis (Mnz_Ω) - AISC F2

Span Geometry

$L_b = 525.3 in$ $C_b = 1.00$ $L_b = 43.8 \cdot ft$

Limiting Lengths

$L_p := 1.76 \cdot \sqrt{\frac{E}{F_y}} \cdot r_y = 198.8 in$ $c := 1.0$ $L_p = 16.6 \cdot ft$

$$L_r := 1.95 \cdot r_{ts} \cdot \frac{E}{0.7 \cdot F_y} \cdot \sqrt{\frac{J_x \cdot c}{S_z \cdot h_0}} \cdot \sqrt{1 + \sqrt{1 + 6.76 \cdot \left(\frac{0.7 \cdot F_y}{E} \cdot \frac{S_z \cdot h_0}{J_x \cdot c}\right)^2}} = 3306 \cdot in$$

$L_r = 275.5 \cdot ft$

Strength

$\Omega_b := 1.67$

$M_{pz} := F_y \cdot Z_z = 83000 \cdot kip \cdot in$

$M_{rz} := 0.7F_y \cdot S_z = 44800 \cdot kip \cdot in$

$$M_{nz} := \begin{cases} M_{pz} & \text{if } L_b \le L_p \\ \min\left[C_b \cdot \left[M_{pz} - (M_{pz} - M_{rz})\left(\frac{L_b - L_p}{L_r - L_p}\right)\right], M_{pz}\right] & \text{if } L_p < L_b \le L_r \\ \min\left[S_z \cdot \left[\frac{C_b \cdot \pi^2 \cdot E}{\left(\frac{L_b}{r_{ts}}\right)^2} \cdot \sqrt{1 + 0.078 \cdot \frac{J_x \cdot c}{S_z \cdot h_0} \cdot \left(\frac{L_b}{r_{ts}}\right)^2}\right], M_{pz}\right] & \text{otherwise} \end{cases} = 78986 \cdot kip \cdot in$$

$$\boxed{M_{nz\_\Omega} := \frac{M_{nz}}{\Omega_b} = 47297 \cdot kip \cdot in}$$

MEMBER = "Main Header Beam" SHAPE = "W14X730" LOADCASE = "MAX DEVELOPED"

Bending Strength - Weak Axis (Mny_Ω) - AISC F6

;take weak bending into 1 flange

$t_f = 4.91\,in$ $b_f = 17.90\,in$ $S_{flange} := \frac{t_f \cdot b_f^2}{6} = 262.2 \cdot in^3$ $Z_{flange} := \frac{t_f \cdot b_f^2}{4} = 393.3 \cdot in^3$

$M_{p\_flange} := F_y \cdot Z_{flange} = 19665 \cdot kip \cdot in$ $M_{y\_flange} := 1.6 F_y \cdot S_{flange} = 20976 \cdot kip \cdot in$

$M_{ny} := \min\left(M_{p\_flange}, M_{y\_flange}\right) = 19665 \cdot kip \cdot in$

$$\boxed{M_{ny\_\Omega} := \frac{M_{ny}}{\Omega_b} = 11776 \cdot kip \cdot in}$$

MEMBER = "Main Header Beam"   SHAPE = "W14X730"   LOADCASE = "MAX DEVELOPED"

Axial Compression & Flexure Strength Ratios

$P_{nx\_\Omega} = 2572.6 \cdot kip$ $P_{ax} = 7.9 \cdot kip$ $SR_{Px} := \frac{P_{ax}}{P_{nx\_\Omega}} = 0.00$

$M_{ny\_\Omega} = 11775.5 \cdot kip \cdot in$ $M_{ay} = 1499.0 \cdot kip \cdot in$ $SR_{My} := \frac{M_{ay}}{M_{ny\_\Omega}} = 0.13$

$M_{nz\_\Omega} = 47296.8 \cdot kip \cdot in$ $M_{az} = 20817.3 \cdot kip \cdot in$ $SR_{Mz} := \frac{M_{az}}{M_{nz\_\Omega}} = 0.44$

Shear Strength Ratios

$V_{ny\_\Omega} = 1375.4 kip$ $V_{ay} = 148.9 kip$ $SR_{Vy} := \frac{V_{ay}}{V_{ny\_\Omega}} = 0.11$

$V_{nz\_\Omega} = 3157.7 kip$ $V_{az} = 11.9 kip$ $SR_{Vz} := \frac{V_{az}}{V_{nz\_\Omega}} = 0.00$

MEMBER = "Main Header Beam"   SHAPE = "W14X730"   LOADCASE = "MAX DEVELOPED"

Axial Compression + Flexure Interation Ratio (AISC H1)

$$IR_{H1\_1} := \begin{cases} \dfrac{P_{ax}}{P_{nx\_\Omega}} + \dfrac{8}{9}\cdot\left(\dfrac{M_{ay}}{M_{ny\_\Omega}} + \dfrac{M_{az}}{M_{nz\_\Omega}}\right) & \text{if } \max\left(\dfrac{P_{ax}}{P_{nx\_\Omega}}\right) \geq 0.2 \\ \dfrac{1}{2}\dfrac{P_{ax}}{P_{nx\_\Omega}} + \left(\dfrac{M_{ay}}{M_{ny\_\Omega}} + \dfrac{M_{az}}{M_{nz\_\Omega}}\right) & \text{otherwise} \end{cases} = 0.57$$

$$\boxed{\text{is}\left(\max\left(IR_{H1\_1}\right) \leq 1.0\right) = \text{"Yes, OK"}}$$

$$\frac{P_{ax}}{P_{nx\_\Omega}} + \frac{8}{9}\cdot\left(\frac{M_{ay}}{M_{ny\_\Omega}} + \frac{M_{az}}{M_{nz\_\Omega}}\right) = 0.51$$

;for reference

$$\frac{1}{2}\frac{P_{ax}}{P_{nx\_\Omega}} + \left(\frac{M_{ay}}{M_{ny\_\Omega}} + \frac{M_{az}}{M_{nz\_\Omega}}\right) = 0.57$$

Deflection - Center Span

$L := L_{span} = 510.0\,in$ $I_z = 14300.0\cdot in^4$ $E = 29000.0\cdot ksi$ $Kettle_{WT\_max} = 304.0\,kip$

$a := 384in$ $b := 126in$ $Rigging_{WT} = 12.0\,kip$

$w_{HB} = 760.6\cdot\dfrac{lbf}{ft}$

$$P := \frac{Kettle_{WT\_max} + Rigging_{WT}}{2} = 158.0\cdot kip$$

$$\delta_{\_y} := \frac{P\cdot a\cdot b\cdot(a+2\cdot b)\cdot\sqrt{3\cdot a\cdot(a+2\cdot b)}}{27\cdot E\cdot I_z\cdot L} + \frac{5\cdot w_{HB}\cdot L^4}{384\cdot E\cdot I_z} = 0.86in$$

$$\frac{L}{\delta_{\_y}} = 590.7$$

$$\boxed{\text{is}\left(\frac{L}{\delta_{\_y}} > 480\right) = \text{"Yes, OK"}}$$

MEMBER = "Main Header Beam"   SHAPE = "W14X730"   LOADCASE = "MAX DEVELOPED"

Concentrated Load Checks - End Reactions

cf_restrain := "no"   ;if the compression flange is restained against rotation - "yes"
if the compression flange is not restrained against rotation - "no"

stiff_R := "no"   ;if bearing stiffeners provided - "yes"
if bearing stiffeners not provided - "no"

$d = 22.40\,in$ $t_w = 3.07\,in$ $t_f = 4.91\,in$ $k_{des} = 5.51\,in$ $F_y = 50.0 \cdot ksi$ $F_u = 65.0 \cdot ksi$ $E = 29000.00 \cdot ksi$

$L_{Load} := \frac{L_{HB} - L_{span}}{2} = 29.0\,in$;distance of load from the end of the member

$N := 0in$;length of bearing (conservative)

$V_{ay} = 148.9\,kip$ $R_{max} := \max(V_{ay}) = 148.9\,kip$;max reaction at leg

Web Local Yielding (AISC J10.2)

$\Omega_{J10.2} := 1.50$ $k_{des} = 5.51\,in$ $N = 0.0$ $F_y = 50.0 \cdot ksi$ $t_w = 3.07\,in$ $L_{Load} = 28.98\,in$ $d = 22.40\,in$

$$R_{n\_J10.2} := \begin{cases} \left[(5 \cdot k_{des} + N) \cdot F_y \cdot t_w\right] & \text{if } L_{Load} > d \\ \left[(2.5 \cdot k_{des} + N) \cdot F_y \cdot t_w\right] & \text{otherwise} \end{cases} = 4228.9\,kip$$

$$R_{n\_J10.2\_\Omega} := \frac{R_{n\_J10.2}}{\Omega_{J10.2}} = 2819.3\,kip$$

$$\boxed{\frac{R_{max}}{R_{n\_J10.2\_\Omega}} = 0.05}$$

Web Crippling (AISC J10.3)

$\Omega_{J10.3} := 2.00$ $t_w = 3.07\,in$ $N = 0.0$ $d = 22.40\,in$ $t_f = 4.91\,in$ $E = 29000.0 \cdot ksi$ $F_y = 50.0 \cdot ksi$ $L_{Load} = 28.98\,in$

$$R_{n\_J10.3} := \begin{cases} \left[0.80 \cdot t_w^{\,2} \cdot \left[1 + 3 \cdot \left(\frac{N}{d}\right) \cdot \left(\frac{t_w}{t_f}\right)^{1.5}\right] \cdot \sqrt{\frac{E \cdot F_y \cdot t_f}{t_w}}\right] & \text{if } L_{Load} \ge \frac{d}{2} \\ \text{otherwise} & \\ \quad \begin{cases} 0.40 \cdot t_w^{\,2} \cdot \left[1 + 3 \cdot \left(\frac{N}{d}\right) \cdot \left(\frac{t_w}{t_f}\right)^{1.5}\right] \cdot \sqrt{\frac{E \cdot F_y \cdot t_f}{t_w}} & \text{if } \frac{N}{d} \le 0.2 \\ 0.40 \cdot t_w^{\,2} \cdot \left[1 + \left(\frac{4N}{d} - 0.2\right) \cdot \left(\frac{t_w}{t_f}\right)^{1.5}\right] \cdot \sqrt{\frac{E \cdot F_y \cdot t_f}{t_w}} & \text{if } \frac{N}{d} > 0.2 \end{cases} \end{cases} = 11482.1\,kip$$

$$R_{n\_J10.3\_\Omega} := \frac{R_{n\_J10.3}}{\Omega_{J10.3}} = 5741.1\,kip$$

$$\boxed{\frac{R_{max}}{R_{n\_J10.3\_\Omega}} = 0.03}$$

MEMBER = "Main Header Beam"   SHAPE = "W14X730"   LOADCASE = "MAX DEVELOPED"

Web Sidesway Buckling (AISC J10.4)

$\Omega_{J10.4} := 1.76$ $t_w = 3.07\,in$ $N = 0.0$ $d = 22.40\,in$ $t_f = 4.91\,in$ $E = 29000.0\cdot ksi$ $F_y = 50.0\cdot ksi$ $L_{Load} = 28.98\,in$

$h = 11.4\,in$ $l := L_b = 525.3\,in$

cf_restrain = "no"   ;if the compression flange is restained against rotation - "yes"
if the compression flange is not restrained against rotation - "no"

stiff_R = "no"   ;if bearing stiffeners provided - "yes"
if bearing stiffeners not provided - "no"

$M_{az} = 20817.3\cdot kip\cdot in$ $M_z := \max(M_{az}) = 20817.3\cdot kip\cdot in$ $M_y := S_z\cdot F_y = 64000.0\cdot kip\cdot in$

$$C_r := \begin{cases} 960000ksi & \text{if } 1.5\cdot M_z < M_y \\ 480000ksi & \text{if } 1.5\cdot M_z \geq M_y \end{cases} = 960000.0\cdot ksi$$

$\left(\frac{h}{t_w}\right) \div \left(\frac{l}{b_f}\right) = 0.13$;for reference

$$R_{n\_J10.4} := \begin{array}{|l} \text{if cf\_restrain} = \text{"yes"} \\ \quad \begin{array}{|l} \frac{C_r\cdot t_w^3\cdot t_f}{h^2}\cdot\left[1+0.4\cdot\left(\frac{\frac{h}{t_w}}{\frac{l}{b_f}}\right)^3\right] \text{ if } \left(\frac{h}{t_w}\right)\div\left(\frac{l}{b_f}\right) \leq 2.3 \\ \text{"J10.4 does not apply" if } \left(\frac{h}{t_w}\right)\div\left(\frac{l}{b_f}\right) > 2.3 \end{array} \\ \text{if cf\_restrain} = \text{"no"} \\ \quad \begin{array}{|l} \frac{C_r\cdot t_w^3\cdot t_f}{h^2}\cdot\left[0.4\cdot\left(\frac{\frac{h}{t_w}}{\frac{l}{b_f}}\right)^3\right] \text{ if } \left(\frac{h}{t_w}\right)\div\left(\frac{l}{b_f}\right) \leq 1.7 \\ \text{"J10.4 does not apply" if } \left(\frac{h}{t_w}\right)\div\left(\frac{l}{b_f}\right) > 1.7 \end{array} \end{array} = 849.1\,kip$$

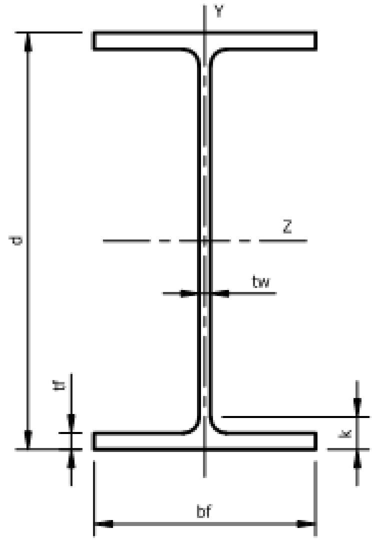
$$R_{n\_J10.4\_\Omega} := \frac{R_{n\_J10.4}}{\Omega_{J10.4}} = 482.4\,kip \qquad \boxed{\frac{R_{max}}{R_{n\_J10.4\_\Omega}} = 0.31}$$

SUMMARY = "All applicable concentrated load checks OK without stiffeners"

3. Cross Beam Analysis

MEMBER = "Cross Beam" SHAPE = "W14X426" LOADCASE = "MAX DEVELOPED"

Section and Material Properties



$d = 18.70\text{in}$ $I_y = 2360.0\cdot\text{in}^4$ $I_z = 6600.0\cdot\text{in}^4$

$t_w = 1.88\text{in}$ $S_y = 283.0\cdot\text{in}^3$ $S_z = 706.0\cdot\text{in}^3$

$b_f = 16.70\text{in}$ $r_y = 4.34\text{in}$ $r_z = 7.26\text{in}$

$t_f = 3.04\text{in}$ $Z_y = 434.0\cdot\text{in}^3$ $Z_z = 869.0\cdot\text{in}^3$

$A_g = 125.0\cdot\text{in}^2$ $J_x = 331.0\cdot\text{in}^4$ $r_{ts} = 5.11\text{in}$

$A_{vy} := d\cdot t_w = 35.2\cdot\text{in}^2$ $k_{des} = 3.63\text{in}$ $C_w = 144000.0\cdot\text{in}^6$

$A_{vz} := 2\cdot b_f\cdot t_f = 101.5\cdot\text{in}^2$ $h_0 = 15.66\text{in}$ $h = 11.44\text{in}$

$F_y := 50\text{ksi}$ $F_u := 65\text{ksi}$ $E = 29000.0\cdot\text{ksi}$

Check Width-Thickness Ratios

CONFIRM ALL ELEMENTS OF THIS SECTION ARE COMPACT FOR BENDING AND SHEAR AND NON-NONSLENDER FOR COMPRESSION, USING AISC TABLE B4.1 OR AS NOTED:

$\lambda_{flange} = 2.75$

$\lambda_{web} = 6.08$

AISC Case 1 $\lambda_{p\_flange\_bend} := 0.38\cdot\sqrt{E \div F_y} = 9.15$ $\text{is}(\lambda_{flange} \le \lambda_{p\_flange\_bend}) = \text{"Yes, OK"}$

AISC Case 3 $\lambda_{r\_flange\_compr} := 0.56\cdot\sqrt{E \div F_y} = 13.49$ $\text{is}(\lambda_{flange} \le \lambda_{r\_flange\_compr}) = \text{"Yes, OK"}$

AISC Case 9 $\lambda_{p\_web\_bend} := 3.76\cdot\sqrt{E \div F_y} = 90.55$ $\text{is}(\lambda_{web} \le \lambda_{p\_web\_bend}) = \text{"Yes, OK"}$

AISC Case 10 $\lambda_{r\_web\_compr} := 1.49\cdot\sqrt{E \div F_y} = 35.88$ $\text{is}(\lambda_{web} \le \lambda_{r\_web\_compr}) = \text{"Yes, OK"}$

AISC G2.1a $\lambda_{web\_shear\_yield} := 2.24\cdot\sqrt{E \div F_y} = 53.95$ $\text{is}(\lambda_{web} \le \lambda_{web\_shear\_yield}) = \text{"Yes, OK"}$

MEMBER = "Cross Beam" SHAPE = "W14X426" LOADCASE = "MAX DEVELOPED"

Cross Beam Internal Loads

$Span := 10ft = 120.0\,in$

$L_{CB} := 19ft + 1in$;length of cross beam

$Wt_{CB} := 9kip$;weight allowance for cross beam

$w_{CB} := \frac{Wt_{CB}}{L_{CB}} = 472 \cdot \frac{lbf}{ft}$;allowance of dist load for cross beam

$Kettle_{WT\_max} = 304.0\,kip$

$Rigging_{WT} = 12.0\,kip$

$Wt_{HB} = 36.0\,kip$

$a := 37.0625in$ $L_{span} := 120in$

$I = 110.0 \cdot \%$ $H_{transv} = 5.0 \cdot \%$ $H_{long} = 10.0 \cdot \%$

$$P_y := \frac{(Kettle_{WT\_max} + Rigging_{WT}) \cdot I}{2} \cdot \left(\frac{384}{510}\right) + \frac{Wt_{HB}}{2} = 148.9 \cdot kip$$

$$V_{ay} := P_y + \frac{Wt_{CB}}{2} = 153.4 \cdot kip$$

$$M_{az} := V_{ay} \cdot a + \frac{w_{CB} \cdot Span^2}{8} = 5754.7 \cdot kip \cdot in$$

$$P_{ax} := \left(\frac{Kettle_{WT\_max} + Rigging_{WT}}{2}\right) \cdot \left(\frac{384}{510}\right) \cdot H_{long} = 11.9 \cdot kip$$

$$T_{ax} := 0kip \cdot in$$

$$V_{az} := \left(\frac{Kettle_{WT\_max} + Rigging_{WT}}{2}\right) \cdot \left(\frac{384}{510}\right) \cdot H_{transv} = 5.9 \cdot kip$$

$$M_{ay} := V_{az} \cdot a = 220.5 \cdot kip \cdot in$$

MEMBER = "Cross Beam"   SHAPE = "W14X426"   LOADCASE = "MAX DEVELOPED"

Beam-Column Geometry

Stiffener := "no"   Bracing := "no"

$L_{span} = 120.0\,in$ $L_b := L_{span} = 120.0\,in$;Lb of span if stiffeners, or Lb of bracing if provided

$$L_{span} + \frac{d}{6}\cdot\left(\frac{t_f}{t_w}\right)^3 = 133.2\,in$$

$$L_b := \begin{cases} L_b & \text{if Stiffener} = \text{"yes"} \vee \text{Bracing} = \text{"yes"} \\ \left[L_{span} + \frac{d}{6}\cdot\left(\frac{t_f}{t_w}\right)^3\right] & \text{if Stiffener} = \text{"no"} \wedge \text{Bracing} = \text{"no"} \wedge \frac{d}{t_w} < 100 \wedge \frac{b_f}{d} < 1 \\ \text{"NG"} & \text{otherwise} \end{cases} = 133.2\,in$$

$L_b = 133.2\,in$ $C_b := 1$

$L_y := L_b = 133.2\,in$ $K_y := 1$

$L_z := L_b = 133.2\,in$ $K_z := 1$

$L_w := L_b = 133.2\,in$

Compression Design Strength (Pnx_Ω) - AISC E3

Slenderness Ratios

$K_y = 1.0$ $L_y = 133.2\,in$ $K_z = 1.0$ $L_z = 133.2\,in$

$\Psi_y := \frac{K_y \cdot L_y}{r_y} = 30.7$ $\Psi_z := \frac{K_z \cdot L_z}{r_z} = 18.3$ $\Psi := \max(\Psi_z, \Psi_y) = 30.7$

$$\Psi_r := 4.71\cdot\sqrt{\frac{E}{F_y}} = 113.4$$

Strength

$\Omega_c := 1.67$

$F_e := \frac{\pi^2 \cdot E}{\Psi^2} = 304.0\cdot ksi$

$$F_{cr} := \begin{cases} \left(0.658^{\frac{F_y}{F_e}}\right)\cdot F_y & \text{if } \Psi \le \Psi_r \\ 0.877\cdot F_e & \text{otherwise} \end{cases} = 46.7\cdot ksi$$

$A_g = 125.0\cdot in^2$

$$\boxed{P_{nx\_\Omega} := \frac{F_{cr}\cdot A_g}{\Omega_c} = 3494\,kip}$$

MEMBER = "Cross Beam"   SHAPE = "W14X426"   LOADCASE = "MAX DEVELOPED"

Shear Strength Web (Vny_Ω) - AISC CHAPTER G

$E = 29000.0 \cdot ksi$ $F_y = 50.0 \cdot ksi$

$h = 11.4in$ $t_w = 1.9in$

$\lambda_{web} = 6.1$ $A_{vy} = 35.2 \cdot in^2$

transverse_stiffeners := "no"   ;either "no" or "yes"

a := 1in   ;transverse stiffener spacing

$$k_v := \left| \begin{array}{l} k_v \leftarrow 5 \ \text{ if transverse\_stiffeners} = \text{"no"} \wedge \lambda_{web} < 260 \\ k_v \leftarrow 5 + \dfrac{5}{\left(\dfrac{a}{h}\right)^2} \ \text{ if transverse\_stiffeners} = \text{"yes"} \\ k_v \leftarrow 5 \ \text{ if transverse\_stiffeners} = \text{"yes"} \wedge \left[\dfrac{a}{h} > 3.0 \vee \dfrac{a}{h} > \left[\dfrac{260}{\left(\dfrac{h}{t_w}\right)}\right]^2\right] \\ k_v \leftarrow \text{"Web too Slender, Redesign"} \ \text{ if } \lambda_{web} \ge 260 \\ \text{return } k_v \end{array} \right. = 5.0$$

$$C_{vy} := \left| \begin{array}{l} C_v \leftarrow 1.0 \ \text{ if } \lambda_{web} \le 2.24 \cdot \sqrt{\dfrac{E}{F_y}} \\ C_v \leftarrow 1.0 \ \text{ if } \lambda_{web} \le 1.10 \cdot \sqrt{\dfrac{k_v \cdot E}{F_y}} \\ C_v \leftarrow \dfrac{1.10 \cdot \sqrt{\dfrac{k_v \cdot E}{F_y}}}{\lambda_{web}} \ \text{ if } 1.10 \cdot \sqrt{\dfrac{k_v \cdot E}{F_y}} < \lambda_{web} \le 1.37 \cdot \sqrt{\dfrac{k_v \cdot E}{F_y}} \\ C_v \leftarrow \dfrac{1.51 \cdot E \cdot k_v}{\lambda_{web}^{\ 2} \cdot F_y} \ \text{ if } \lambda_{web} > 1.37 \cdot \sqrt{\dfrac{k_v \cdot E}{F_y}} \\ \text{return } C_v \end{array} \right. = 1.0$$

$V_{ny} := 0.6 \cdot F_y \cdot A_{vy} \cdot C_{vy} = 1054.7kip$

Strength

$$\Omega_v := \left| \begin{array}{l} \Omega_v \leftarrow 1.50 \ \text{ if } \lambda_{web} \le 2.24 \cdot \sqrt{\dfrac{E}{F_y}} \\ \Omega_v \leftarrow 1.67 \ \text{ if } \lambda_{web} > 2.24 \cdot \sqrt{\dfrac{E}{F_y}} \end{array} \right. = 1.5$$

$$\boxed{V_{ny\_\Omega} := \dfrac{V_{ny}}{\Omega_v} = 703 \cdot kip}$$

MEMBER = "Cross Beam" SHAPE = "W14X426" LOADCASE = "MAX DEVELOPED"

Shear Strength - Flanges (Vnz_Ω) - AISC SECTION G7

$\Omega_{vz} := 1.67$ $A_{vz} = 101.5 \cdot in^2$ $F_y = 50.0 \cdot ksi$

$C_{vz} := 1.0$

$V_{nz} := (0.6 \cdot F_y) \cdot A_{vz} \cdot C_{vz} = 3046 kip$

$\boxed{V_{nz\_\Omega} := \frac{V_{nz}}{\Omega_{vz}} = 1824 \cdot kip}$

Bending Strength - Strong Axis (Mnz_Ω) - AISC F2

Span Geometry

$L_b = 133.2 in$ $C_b = 1.00$ $L_b = 11.1 \cdot ft$

Limiting Lengths

$L_p := 1.76 \cdot \sqrt{\frac{E}{F_y}} \cdot r_y = 184.0 in$ $c := 1.0$ $L_p = 15.3 \cdot ft$

$$L_r := 1.95 \cdot r_{ts} \cdot \frac{E}{0.7 \cdot F_y} \cdot \sqrt{\frac{J_x \cdot c}{S_z \cdot h_0}} \cdot \sqrt{1 + \sqrt{1 + 6.76 \cdot \left(\frac{0.7 \cdot F_y}{E} \cdot \frac{S_z \cdot h_0}{J_x \cdot c}\right)^2}} = 2023 \cdot in$$

$L_r = 168.6 \cdot ft$

Strength

$\Omega_b := 1.67$

$M_{pz} := F_y \cdot Z_z = 43450 \cdot kip \cdot in$

$M_{rz} := 0.7 F_y \cdot S_z = 24710 \cdot kip \cdot in$

$$M_{nz} := \begin{cases} M_{pz} & \text{if } L_b \le L_p \\ \min\left[C_b \cdot \left[M_{pz} - (M_{pz} - M_{rz})\left(\frac{L_b - L_p}{L_r - L_p}\right)\right], M_{pz}\right] & \text{if } L_p < L_b \le L_r \\ \min\left[S_z \cdot \left[\frac{C_b \cdot \pi^2 \cdot E}{\left(\frac{L_b}{r_{ts}}\right)^2} \cdot \sqrt{1 + 0.078 \cdot \frac{J_x \cdot c}{S_z \cdot h_0} \cdot \left(\frac{L_b}{r_{ts}}\right)^2}\right], M_{pz}\right] & \text{otherwise} \end{cases} = 43450 \cdot kip \cdot in$$

$\boxed{M_{nz\_\Omega} := \frac{M_{nz}}{\Omega_b} = 26018 \cdot kip \cdot in}$

MEMBER = "Cross Beam"   SHAPE = "W14X426"   LOADCASE = "MAX DEVELOPED"

Bending Strength - Weak Axis (Mny_Ω) - AISC F6

;take weak bending into 1 flange

$t_f = 3.04 in$ $b_f = 16.70 in$ $S_{flange} := \frac{t_f \cdot b_f^2}{6} = 141.3 \cdot in^3$ $Z_{flange} := \frac{t_f \cdot b_f^2}{4} = 212.0 \cdot in^3$

$M_{p\_flange} := F_y \cdot Z_{flange} = 10598 \cdot kip \cdot in$ $M_{y\_flange} := 1.6 F_y \cdot S_{flange} = 11304 \cdot kip \cdot in$

$M_{ny} := \min(M_{p\_flange}, M_{y\_flange}) = 10598 \cdot kip \cdot in$

$$\boxed{M_{ny\_\Omega} := \frac{M_{ny}}{\Omega_b} = 6346 \cdot kip \cdot in}$$

MEMBER = "Cross Beam"   SHAPE = "W14X426"   LOADCASE = "MAX DEVELOPED"

Axial Compression & Flexure Strength Ratios

$P_{nx\_\Omega} = 3493.5 \cdot kip$ $P_{ax} = 11.9 \cdot kip$ $SR_{Px} := \dfrac{P_{ax}}{P_{nx\_\Omega}} = 0.00$

$M_{ny\_\Omega} = 6346.0 \cdot kip \cdot in$ $M_{ay} = 220.5 \cdot kip \cdot in$ $SR_{My} := \dfrac{M_{ay}}{M_{ny\_\Omega}} = 0.03$

$M_{nz\_\Omega} = 26018.0 \cdot kip \cdot in$ $M_{az} = 5754.7 \cdot kip \cdot in$ $SR_{Mz} := \dfrac{M_{az}}{M_{nz\_\Omega}} = 0.22$

Shear Strength Ratios

$V_{ny\_\Omega} = 703.1\, kip$ $V_{ay} = 153.4\, kip$ $SR_{Vy} := \dfrac{V_{ay}}{V_{ny\_\Omega}} = 0.22$

$V_{nz\_\Omega} = 1824.0\, kip$ $V_{az} = 5.9\, kip$ $SR_{Vz} := \dfrac{V_{az}}{V_{nz\_\Omega}} = 0.00$

MEMBER = "Cross Beam" SHAPE = "W14X426" LOADCASE = "MAX DEVELOPED"

Axial Compression + Flexure Interation Ratio (AISC H1)

$$IR_{H1\_1} := \begin{cases} \frac{P_{ax}}{P_{nx\_\Omega}} + \frac{8}{9}\cdot\left(\frac{M_{ay}}{M_{ny\_\Omega}} + \frac{M_{az}}{M_{nz\_\Omega}}\right) & \text{if } \max\left(\frac{P_{ax}}{P_{nx\_\Omega}}\right) \ge 0.2 \\ \frac{1}{2}\frac{P_{ax}}{P_{nx\_\Omega}} + \left(\frac{M_{ay}}{M_{ny\_\Omega}} + \frac{M_{az}}{M_{nz\_\Omega}}\right) & \text{otherwise} \end{cases} = 0.26$$

$\boxed{is(\max(IR_{H1\_1}) \le 1.0) = \text{"Yes, OK"}}$

$$\frac{P_{ax}}{P_{nx\_\Omega}} + \frac{8}{9}\cdot\left(\frac{M_{ay}}{M_{ny\_\Omega}} + \frac{M_{az}}{M_{nz\_\Omega}}\right) = 0.23$$

;for reference

$$\frac{1}{2}\frac{P_{ax}}{P_{nx\_\Omega}} + \left(\frac{M_{ay}}{M_{ny\_\Omega}} + \frac{M_{az}}{M_{nz\_\Omega}}\right) = 0.26$$

Deflection - Center Span

$L := L_{span} = 120.0\,in$ $I_z = 6600.0\cdot in^4$ $E = 29000.0\cdot ksi$ $Kettle_{WT\_max} = 304.0\,kip$ $Wt_{HB} = 36.0\,kip$

$a := 37.0625\,in$ $Rigging_{WT} = 12.0\,kip$

$w_{CB} = 471.6\cdot\frac{lbf}{ft}$

$$P := \frac{Kettle_{WT\_max} + Rigging_{WT}}{2}\cdot\left(\frac{384}{510}\right) + \frac{Wt_{HB}}{2} = 137.0\cdot kip$$

$$\delta_{\_y} := \frac{P\cdot a}{24\cdot E\cdot I_z}\cdot\left(3\cdot L^2 - 4\cdot a^2\right) + \frac{5\cdot w_{CB}\cdot L^4}{384\cdot E\cdot I_z} = 0.04\,in$$

$\frac{L}{\delta_{\_y}} = 2842.1$ $\boxed{is\left(\frac{L}{\delta_{\_y}} > 480\right) = \text{"Yes, OK"}}$

MEMBER = "Cross Beam"   SHAPE = "W14X426"   LOADCASE = "MAX DEVELOPED"

Concentrated Load Checks - End Reactions

cf_restrain := "no"   ;if the compression flange is restained against rotation - "yes"
if the compression flange is not restrained against rotation - "no"

stiff_R := "no"   ;if bearing stiffeners provided - "yes"
if bearing stiffeners not provided - "no"

$d = 18.70\,in$ $t_w = 1.88\,in$ $t_f = 3.04\,in$ $k_{des} = 3.63\,in$ $F_y = 50.0 \cdot ksi$ $F_u = 65.0 \cdot ksi$ $E = 29000.00 \cdot ksi$

$L_{Load} := \frac{L_{CB} - L_{span}}{2} = 54.5\,in$;distance of load from the end of the member

$N := 0\,in$;length of bearing (conservative)

$V_{ay} = 153.4\,kip$ $R_{max} := \max(V_{ay}) = 153.4\,kip$;max reaction at leg

Web Local Yielding (AISC J10.2)

$\Omega_{J10.2} := 1.50$ $k_{des} = 3.63\,in$ $N = 0.0$ $F_y = 50.0 \cdot ksi$ $t_w = 1.88\,in$ $L_{Load} = 54.50\,in$ $d = 18.70\,in$

$$R_{n\_J10.2} := \begin{cases} \left[(5 \cdot k_{des} + N) \cdot F_y \cdot t_w\right] & \text{if } L_{Load} > d \\ \left[(2.5 \cdot k_{des} + N) \cdot F_y \cdot t_w\right] & \text{otherwise} \end{cases} = 1706.1\,kip$$

$$R_{n\_J10.2\_\Omega} := \frac{R_{n\_J10.2}}{\Omega_{J10.2}} = 1137.4\,kip$$

$$\boxed{\frac{R_{max}}{R_{n\_J10.2\_\Omega}} = 0.13}$$

Web Crippling (AISC J10.3)

$\Omega_{J10.3} := 2.00$ $t_w = 1.88\,in$ $N = 0.0$ $d = 18.70\,in$ $t_f = 3.04\,in$ $E = 29000.0 \cdot ksi$ $F_y = 50.0 \cdot ksi$ $L_{Load} = 54.50\,in$

$$R_{n\_J10.3} := \begin{cases} \left[0.80 \cdot t_w^2 \cdot \left[1 + 3 \cdot \left(\frac{N}{d}\right) \cdot \left(\frac{t_w}{t_f}\right)^{1.5}\right] \cdot \sqrt{\frac{E \cdot F_y \cdot t_f}{t_w}}\right] & \text{if } L_{Load} \ge \frac{d}{2} \\ \text{otherwise} & \\ \quad \begin{cases} 0.40 \cdot t_w^2 \cdot \left[1 + 3 \cdot \left(\frac{N}{d}\right) \cdot \left(\frac{t_w}{t_f}\right)^{1.5}\right] \cdot \sqrt{\frac{E \cdot F_y \cdot t_f}{t_w}} & \text{if } \frac{N}{d} \le 0.2 \\ 0.40 \cdot t_w^2 \cdot \left[1 + \left(\frac{4N}{d} - 0.2\right) \cdot \left(\frac{t_w}{t_f}\right)^{1.5}\right] \cdot \sqrt{\frac{E \cdot F_y \cdot t_f}{t_w}} & \text{if } \frac{N}{d} > 0.2 \end{cases} & \end{cases} = 4329.6\,kip$$

$$R_{n\_J10.3\_\Omega} := \frac{R_{n\_J10.3}}{\Omega_{J10.3}} = 2164.8\,kip$$

$$\boxed{\frac{R_{max}}{R_{n\_J10.3\_\Omega}} = 0.07}$$

MEMBER = "Cross Beam" SHAPE = "W14X426" LOADCASE = "MAX DEVELOPED"

Web Sidesway Buckling (AISC J10.4)

$\Omega_{J10.4} := 1.76$ $t_w = 1.88\,in$ $N = 0.0$ $d = 18.70\,in$ $t_f = 3.04\,in$ $E = 29000.0\cdot ksi$ $F_y = 50.0\cdot ksi$ $L_{Load} = 54.50\,in$

$h = 11.4\,in$ $l := L_b = 133.2\,in$

cf_restrain = "no" ;if the compression flange is restained against rotation - "yes"
if the compression flange is not restrained against rotation - "no"

stiff_R = "no" ;if bearing stiffeners provided - "yes"
if bearing stiffeners not provided - "no"

$M_{az} = 5754.7\cdot kip\cdot in$ $M_z := \max(M_{az}) = 5754.7\cdot kip\cdot in$ $M_y := S_z\cdot F_y = 35300.0\cdot kip\cdot in$

$$C_r := \begin{cases} 960000ksi & \text{if } 1.5\cdot M_z < M_y \\ 480000ksi & \text{if } 1.5\cdot M_z \ge M_y \end{cases} = 960000.0\cdot ksi$$

$$\left(\frac{h}{t_w}\right) \div \left(\frac{l}{b_f}\right) = 0.76$$;for reference

$$R_{n\_J10.4} := \begin{cases} \text{if cf\_restrain} = \text{"yes"} & \begin{cases} \dfrac{C_r\cdot t_w^{3}\cdot t_f}{h^2}\cdot\left[1 + 0.4\cdot\left(\dfrac{\frac{h}{t_w}}{\frac{l}{b_f}}\right)^3\right] & \text{if } \left(\dfrac{h}{t_w}\right) \div \left(\dfrac{l}{b_f}\right) \le 2.3 \\ \text{"J10.4 does not apply"} & \text{if } \left(\dfrac{h}{t_w}\right) \div \left(\dfrac{l}{b_f}\right) > 2.3 \end{cases} \\ \text{if cf\_restrain} = \text{"no"} & \begin{cases} \dfrac{C_r\cdot t_w^{3}\cdot t_f}{h^2}\cdot\left[0.4\cdot\left(\dfrac{\frac{h}{t_w}}{\frac{l}{b_f}}\right)^3\right] & \text{if } \left(\dfrac{h}{t_w}\right) \div \left(\dfrac{l}{b_f}\right) \le 1.7 \\ \text{"J10.4 does not apply"} & \text{if } \left(\dfrac{h}{t_w}\right) \div \left(\dfrac{l}{b_f}\right) > 1.7 \end{cases} \end{cases} = 26332.2\,kip$$

$$R_{n\_J10.4\_\Omega} := \frac{R_{n\_J10.4}}{\Omega_{J10.4}} = 14961.4\,kip$$

$$\boxed{\frac{R_{max}}{R_{n\_J10.4\_\Omega}} = 0.01}$$

SUMMARY = "All applicable concentrated load checks OK without stiffeners"

4. Gantry Analysis - 700T Gantry System (HG700 (J&R 1400 Series))

Gantry Leg Capacity Check

$Kettle_{WT\_max} = 304.0 kip$;from before

$Rigging_{WT} = 12.0 kip$ $Wt_{HB} = 36.0 \cdot kip$ $Wt_{CB} = 9.0 kip$;allowances

$$P_g := \frac{Wt_{HB} + Wt_{CB}}{2} + \frac{Kettle_{WT\_max} + Rigging_{WT}}{2} \cdot \left(\frac{384}{510}\right) = 141.5 kip$$

$P_g = 141.5 \cdot kip$;gantry max unfactored vertical load at top of gantry leg.

$Gantry_{scope} := 30.58 ft = 367.0 in$;maximum anticipated leg scope during operation

;for use of gantry as shown on DWG 001 sheet 3, 2nd stage without manual extended

$$Gantry_{capacity} := \begin{cases} \dfrac{700tonf}{4} & \text{if } 13.83ft \le Gantry_{scope} \le 22.42ft \\ \dfrac{470tonf}{4} & \text{if } 22.42ft < Gantry_{scope} \le 30.58ft \\ \text{"Outside of Gantry Scope Range"} & \text{otherwise} \end{cases} = 235.0 \cdot kip$$

$$\boxed{\frac{P_g}{Gantry_{capacity}} = 0.60}$$

Gantry Tower Stability (as presented by "Rigging with Gantries" David Duerr 1994)

Parameters: Overall gantry and geometry and variable definitions.

Loads

$P_g = 141.5 \cdot kip$;Applied Vertical Load (service load) to top of gantry leg (see above)

$W_g := 22.3 \cdot kip$;gantry single leg dead load

$F_{lat} := H_{transv} \cdot P_g = 7.1 \cdot kip$;Lateral Load to gantry leg

$F_{long} := H_{long} \cdot P_g = 14.1 \cdot kip$;Longitudinal load to gantry leg

Geometry

$Gantry_{scope} = 30.6 \cdot ft$ $d_{beams} := 45 in$

$H_g := Gantry_{scope} + d_{beams} = 412.0 \cdot in$;Gantry leg extension, use max leg scope + depth of header/cross beams

$h_{cg} := 40\% \cdot Gantry_{scope} = 146.78 \cdot in$;Assumed leg CG value at 40% extended height

$T_g := 46.625 in = 46.625 in$;Track width of jacking unit outside wheel to wheel

$G_g := 36 in$;Track Beam Spacing (gage)

$WB_g := 87.5 in$;Wheelbase wheel to weel longitudinal

$\Delta := \frac{1in}{120in} \cdot (Gantry_{scope} - 13.83ft) = 1.67 in$;Predicted displacement of top of gantry leg due to boom clearances: ~1" for 10ft extension. This is an assumption to accomodate for additional out of plumbness due to lateral loads.

Runway Track Data

$Percent_{lat} := \frac{\frac{1}{8}in}{36in} = 0.347 \cdot \%$;Track lateral slope
Accounts for levelness

$\theta_{lat} := atan(Percent_{lat}) = 0.199 \cdot deg$;Runway track rotation (lateral)

$Percent_{long} := \frac{\frac{1}{2}in}{120in} = 0.417 \cdot \%$;Track longitudinal slope
Accounts for levelness

$\theta_{long} := atan(Percent_{long}) = 0.239 \cdot deg$;Runway track rotation (longitudinal)

Analysis

$H_{v\_lat} := H_g \cdot cos(\theta_{lat}) = 412.0 \cdot in$;Vertical projection of gantry extended height 'H' for lateral slope

$H_{v\_long} := H_g \cdot cos(\theta_{long}) = 412.0 \cdot in$;Vertical projection of gantry extended height 'H' for longitudinal slope

$T_h := T_g \cdot cos(\theta_{lat}) = 46.62 \cdot in$;Horizontal projection of track width of Jack Unit for lateral slope

$T_v := T_g \cdot sin(\theta_{lat}) = 0.162 \cdot in$;Difference in elevation of track beams from lateral slope.

$WB_h := WB_g \cdot cos(\theta_{long}) = 87.50 in$;Wheelbase horizontal projection for longitudinal slope

$WB_v := WB_g \cdot sin(\theta_{long}) = 0.365 in$;Wheelbase difference in elevation from longitudinal slope

$\delta_{latll} := H_g \cdot sin(\theta_{lat}) = 1.430 in$;Lateral displacement of boom top due to lateral slope

$\delta_{latdl} := h_{cg} \cdot sin(\theta_{lat}) = 0.510 in$;Lateral displacement of CG due to lateral slope

$\delta_{longll} := H_g \cdot sin(\theta_{long}) = 1.716 in$;Longitudinal displacement of boom top due to longitudinal slope

$\delta_{longdl} := h_{cg} \cdot sin(\theta_{long}) = 0.612 in$;Longitudinal displacement of CG due to due to longitudinal slope

Stability Results:

Lift_Type = "dynamic"

Safety Factor against Tipping: Lateral direction

$MR_{lat} := P_g \cdot \left(\frac{T_h}{2} - \delta_{latll} - \Delta\right) + W_g \cdot \left(\frac{T_h}{2} - \delta_{latdl}\right) = 3367.1 \cdot kip \cdot in$;Righting Moment

$MO_{lat} := H_{v\_lat} \cdot F_{lat} = 2913.9 \cdot kip \cdot in$;Overturning Moment

$OverturnSF_{lat} := \frac{MR_{lat}}{MO_{lat}} = 1.16$ $\boxed{is(OverturnSF_{lat} \geq 1.1) = \text{"Yes, OK"}}$;conservative lateral loading, maintain greater than 1.1 minimum

Safety Factor against Tipping: Longitudinal direction

$MR_{long} := P_g \cdot \left(\frac{WB_h}{2} - \delta_{longll} - \Delta \right) + W_g \cdot \left(\frac{WB_h}{2} - \delta_{longdl} \right) = 6671.2 \cdot kip \cdot in$;Righting Moment

$MO_{long} := H_{v\_long} \cdot F_{long} = 5827.7 \cdot kip \cdot in$;Overturning Moment

$$OverturnSF_{long} := \frac{MR_{long}}{MO_{long}} = 1.14$$

$\boxed{is(OverturnSF_{long} \geq 1.1) = \text{"Yes, OK"}}$;conservative lateral loading, maintain greater than 1.1 minimum

5. TRACK AND CRIBBING ANALYSIS

Conservative check assuming toe and heel point loads (due to deflection, actual is distributed).

Impact factors

$E := 29000ksi$ $\quad I = 110.0 \cdot \%$ $\quad H_{long} = 10.0 \cdot \%$ $\quad H_{transv} = 5.0 \cdot \%$

$W_g = 22.30kip$ $\quad P_g = 141.5kip$

$Wg_{bj} := W_g + P_g = 163.8 \cdot kip$;Net load at base of jacks

$H_g = 412.0 \cdot in$;Maximum gantry ht during lift (scope + depth of beams)

$WB_g = 87.5in$;Gantry wheelbase

$G_g = 36.0in$;Gantry wheel gauge

$s_{supp} := 30in = 30.0in$;Max. support spacing

$w_{tr} := 280plf = 0.02333 \cdot \frac{kip}{in}$;Track weight

$W_{tr} := s_{supp} \cdot w_{tr} = 0.700 \cdot kip$;Net track weight per span

Gantry Corner Loads

$Pg_{whl} := \frac{W_g + P_g}{4} = 40.9 \cdot kip$;Basic corner load (LL + DL)

$Pg_{1y} := \frac{I \cdot (P_g)}{4} + \frac{W_g}{4} = 44.5 \cdot kip$;Load combination 1. (I*LL + DL)

$Pg_{2y\_max} := Pg_{1y} + \frac{(H_{transv} \cdot P_g) \cdot H_g}{2 \cdot G_g} = 84.9 \cdot kip$;Load combination 2 max. (I*LL + DL + Htransv*LL)

$Pg_{2y\_min} := Pg_{1y} - \frac{(H_{transv} \cdot P_g) \cdot H_g}{2 \cdot G_g} = 4.0 \cdot kip$;Load combination 2 min. (I*LL + DL - Htransv*LL)

$Pg_{3y\_max} := Pg_{1y} + \frac{(H_{long} \cdot P_g) \cdot H_g}{2 \cdot WB_g} = 77.8 \cdot kip$;Load combination 3 max. (I*LL + DL + Hlong*LL)

$Pg_{3y\_min} := Pg_{1y} - \frac{(H_{long} \cdot P_g) \cdot H_g}{2 \cdot WB_g} = 11.2 \cdot kip$;Load combination 3 min. (I*LL + DL - Hlong*LL)

$Pg_{max} := \max(Pg_{1y}, Pg_{2y\_max}, Pg_{3y\_max}) = 84.9 \cdot kip$;Max gantry corner load from all load combinations

Section properties

$b_{f\_track} := 12in$ $\quad t_f := 0.75in$ $\quad F_y := 36ksi$ $\quad d := 15.5in$

$h_w := 14in$ $\quad t_w := 0.375in$ $\quad S_z := 148.6in^3$

$y_{na} := 7.75in$ $\quad y_p := y_{na}$ $\quad Z_z := 169.5in^3$ $\quad I_z := 1151.4in^4$

$A_w := 2h_w \cdot t_w = 10.5 \cdot in^2$

Check Width-Thickness Ratios

Flange Compactness

$$\lambda_f := \frac{b_{f\_track}}{t_f} = 16.0$$

$$Flange := if\left(\lambda_f > 1.12 \cdot \sqrt{\frac{E}{F_y}}, if\left(\lambda_f > 1.4\sqrt{\frac{E}{F_y}}, \text{"Slender"}, \text{"Noncompact"}\right), \text{"Compact"}\right) = \text{"Compact"}$$

Web Compactness

$$\lambda_w := \frac{h_w}{t_w} = 37.3$$

$$Web := if\left(\lambda_w > 2.42 \cdot \sqrt{\frac{E}{F_y}}, if\left(\lambda_w > 5.7\sqrt{\frac{E}{F_y}}, \text{"Slender"}, \text{"Noncompact"}\right), \text{"Compact"}\right) = \text{"Compact"}$$

Bending Strength - Strong Axis (Mnz_Ω) - AISC F7

Bending Case: Single wheel at midspan

$$M1_g := \frac{Pg_{max} \cdot s_{supp}}{4} + w_{tr} \cdot \frac{s_{supp}^2}{8} = 639.7 \cdot kip \cdot in$$;Bending moment

Bending Case: Two wheel moving load

$$x := if\left[WB_g < 0.586 \cdot s_{supp}, 0.5 \cdot \left(s_{supp} - \frac{WB_g}{2}\right), \frac{s_{supp}}{2}\right] = 15.0 \cdot in$$;Load location

$$M2_g := if\left[WB_g < 0.586 \cdot s_{supp}, \frac{Pg_{max}}{2 \cdot s_{supp}} \cdot \left(s_{supp} - \frac{WB_g}{2}\right)^2, \frac{Pg_{max} \cdot s_{supp}}{4}\right] = 637.1 \cdot kip \cdot in$$

$$M_{max} := max\left(M1_g, if\left(x > s_{supp} - WB_g, 0, M2_g\right)\right) = 639.7 \cdot kip \cdot in$$

Strength

$\Omega_b := 1.67$;Bending safety factor

$$M_{nz\_\Omega} := \frac{F_y \cdot Z_z}{\Omega_b} = 3653.9 \cdot kip \cdot in \qquad \boxed{\frac{M_{max}}{M_{nz\_\Omega}} = 0.18}$$;Allowable Flexural Strength

Shear Strength - Webs (Vny_Ω) - AISC G

$$V_{max} := if\left[WB_g > s_{supp}, Pg_{max}, Pg_{max} \cdot \left(2 - \frac{WB_g}{s_{supp}}\right)\right] + W_{tr} = 85.6 \cdot kip$$

Allowable Shear

$k_v := 5$;Web plate buckling coefficient

$$C_v := if\left(\lambda_w > 1.1 \cdot \sqrt{\frac{k_v \cdot E}{F_y}}, if\left(\lambda_w > 1.37\sqrt{\frac{k_v \cdot E}{F_y}}, \frac{1.51 \cdot E \cdot k_v}{\lambda_w^2 \cdot F_y}, \frac{1.1 \cdot \sqrt{\frac{k_v \cdot E}{F_y}}}{\lambda_w}\right), 1\right) = 1.0$$

$V_n := 0.6 \cdot F_y \cdot A_w \cdot C_v = 226.8 \cdot kip$;Nominal shear strength

$\Omega_v := 1.67$;Shear safety factor

$V_{ny\_\Omega} := \frac{V_n}{\Omega_v} = 135.8 \cdot kip$ $\boxed{\frac{V_{max}}{V_{ny\_\Omega}} = 0.63}$;Allowable shear strength

Deflection check

Gantry Track Analysis

$Pg_{max} = 84.9 \cdot kip$ $s_{supp} = 30.0 in$ $E = 29000.0 \cdot ksi$ $I_z = 1151.4 \cdot in^4$ $w_{tr} = 0.02333 \cdot \frac{kip}{in}$

$\delta_{estimate} := \frac{Pg_{max} \cdot s_{supp}^3}{48 \cdot E \cdot I_z} + \frac{5 w_{tr} \cdot s_{supp}^4}{384 \cdot E \cdot I_z} = 0.00144 in$ $\frac{s_{supp}}{\delta_{estimate}} = 20856.3$ $\boxed{is\left(\frac{s_{supp}}{\delta_{estimate}} > 960\right) = \text{"Yes, OK"}}$

Local Force Check (per web)

Concentrated Load Checks - End Reactions

cf_restrain := "yes" ;if the compression flange is restained against rotation - "yes"
if the compression flange is not restrained against rotation - "no"

stiff_R := "no" ;if bearing stiffeners provided - "yes"
if bearing stiffeners not provided - "no"

$d = 15.50 in$ $t_w = 0.38 in$ $t_f = 0.75 in$ $k_{des} := t_f \cdot 1.5 = 1.13 in$ $F_y = 36.0 \cdot ksi$ $F_u = 65.0 \cdot ksi$ $E = 29000.00 \cdot ksi$

$L_{Load} := 24 in$;distance of load from the end of the member

$N := 0 in$;length of bearing (conservative)

$V_{max} = 85.6 \cdot kip$ $R_{max} := \frac{V_{max}}{2} = 42.8 \cdot kip$;max reaction wheel (2-wheels per corner reaction)

Web Local Yielding (AISC J10.2)

$\Omega_{J10.2} := 1.50$ $k_{des} = 1.13 in$ $N = 0.0$ $F_y = 36.0 \cdot ksi$ $t_w = 0.38 in$ $L_{Load} = 24.00 in$ $d = 15.50 in$

$$R_{n\_J10.2} := \begin{cases} \left[(5 \cdot k_{des} + N) \cdot F_y \cdot t_w\right] & \text{if } L_{Load} > d \\ \left[(2.5 \cdot k_{des} + N) \cdot F_y \cdot t_w\right] & \text{otherwise} \end{cases} = 75.9 \cdot kip$$

$R_{n\_J10.2\_\Omega} := \frac{R_{n\_J10.2}}{\Omega_{J10.2}} = 50.6 \cdot kip$ $\boxed{\frac{R_{max}}{R_{n\_J10.2\_\Omega}} = 0.85}$

Web Crippling (AISC J10.3)

$\Omega_{J10.3} := 2.00$ $t_w = 0.38in$ $N = 0.0$ $d = 15.50in$ $t_f = 0.75in$ $E = 29000.0 \cdot ksi$ $F_y = 36.0 \cdot ksi$ $L_{Load} = 24.00in$

$$R_{n\_J10.3} := \begin{cases} \left[0.80 \cdot t_w^2 \cdot \left[1 + 3 \cdot \left(\frac{N}{d}\right) \cdot \left(\frac{t_w}{t_f}\right)^{1.5}\right] \cdot \sqrt{\frac{E \cdot F_y \cdot t_f}{t_w}}\right] & \text{if } L_{Load} \geq \frac{d}{2} \\ \text{otherwise} & \\ \quad \begin{cases} 0.40 \cdot t_w^2 \cdot \left[1 + 3 \cdot \left(\frac{N}{d}\right) \cdot \left(\frac{t_w}{t_f}\right)^{1.5}\right] \cdot \sqrt{\frac{E \cdot F_y \cdot t_f}{t_w}} & \text{if } \frac{N}{d} \leq 0.2 \\ 0.40 \cdot t_w^2 \cdot \left[1 + \left(\frac{4N}{d} - 0.2\right) \cdot \left(\frac{t_w}{t_f}\right)^{1.5}\right] \cdot \sqrt{\frac{E \cdot F_y \cdot t_f}{t_w}} & \text{if } \frac{N}{d} > 0.2 \end{cases} & \end{cases} = 162.6 \cdot kip$$

$$R_{n\_J10.3\_\Omega} := \frac{R_{n\_J10.3}}{\Omega_{J10.3}} = 81.3 \cdot kip$$

$$\boxed{\frac{R_{max}}{R_{n\_J10.3\_\Omega}} = 0.53}$$

Web Sidesway Buckling (AISC J10.4)

$\Omega_{J10.4} := 1.76$ $t_w = 0.38in$ $N = 0.0$ $d = 15.50in$ $t_f = 0.75in$ $E = 29000.0 \cdot ksi$ $F_y = 36.0 \cdot ksi$ $L_{Load} = 24.00in$

$h := h_w = 14.0in$ $l := s_{supp} = 30.0in$ $b_f := b_{f\_track} = 12.0in$

cf_restrain = "yes" ;if the compression flange is restained against rotation - "yes"
if the compression flange is not restrained against rotation - "no"

stiff_R = "no" ;if bearing stiffeners provided - "yes"
if bearing stiffeners not provided - "no"

$S_z = 148.6 \cdot in^3$ $F_y = 36.0 \cdot ksi$

$M_z = 5754.7 \cdot kip \cdot in$ $M_y := S_z \cdot F_y = 5349.6 \cdot kip \cdot in$

$$C_r := \begin{cases} 960000ksi & \text{if } 1.5 \cdot M_z < M_y \\ 480000ksi & \text{if } 1.5 \cdot M_z \geq M_y \end{cases} = 480000.0 \cdot ksi$$

$$\left(\frac{h}{t_w}\right) \div \left(\frac{l}{b_f}\right) = 14.93$$;for reference

$$R_{n\_J10.4} := \begin{cases} \text{if } cf\_restrain = \text{"yes"} \\ \quad \begin{cases} \dfrac{C_r \cdot t_w^{\,3} \cdot t_f}{h^2} \cdot \left[1 + 0.4 \cdot \left(\dfrac{\frac{h}{t_w}}{\frac{l}{b_f}}\right)^3\right] & \text{if } \left(\frac{h}{t_w}\right) \div \left(\frac{l}{b_f}\right) \le 2.3 \\ \text{"J10.4 does not apply"} & \text{if } \left(\frac{h}{t_w}\right) \div \left(\frac{l}{b_f}\right) > 2.3 \end{cases} \\ \text{if } cf\_restrain = \text{"no"} \\ \quad \begin{cases} \dfrac{C_r \cdot t_w^{\,3} \cdot t_f}{h^2} \cdot \left[0.4 \cdot \left(\dfrac{\frac{h}{t_w}}{\frac{l}{b_f}}\right)^3\right] & \text{if } \left(\frac{h}{t_w}\right) \div \left(\frac{l}{b_f}\right) \le 1.7 \\ \text{"J10.4 does not apply"} & \text{if } \left(\frac{h}{t_w}\right) \div \left(\frac{l}{b_f}\right) > 1.7 \end{cases} \end{cases} = \text{"J10.4 does not apply"}$$

$$R_{n\_J10.4\_\Omega} := \begin{cases} \dfrac{R_{n\_J10.4}}{\Omega_{J10.4}} & \text{if } R_{n\_J10.4} \ne \text{"J10.4 does not apply"} \\ \text{"J10.4 does not apply"} & \text{otherwise} \end{cases} = \text{"J10.4 does not apply"}$$

$$\boxed{SR := \begin{cases} \dfrac{R_{max}}{R_{n\_J10.4\_\Omega}} & \text{if } R_{n\_J10.4} \ne \text{"J10.4 does not apply"} \\ \text{"J10.4 does not apply"} & \text{otherwise} \end{cases} = \text{"J10.4 does not apply"}}$$

Timber & Ground Bearing Analysis (static only)

Analysis assumes that static maximum bearing pressure will be provided by customer and dynamic loading (from lateral forces) are minimal in occurance.

$w_{gt} := 280\frac{lbf}{ft}$;gantry track unit weight

$L_{gt} := 20ft$;gantry track length

$W_{gt} := L_{gt} \cdot w_{gt} = 5.6 \cdot kip$;gantry track weight

$L_{timber} := 4ft$;Length of supporting timbers

$b_{timber} := 7.5in$;Width of supporting timbers

$N_{timber\_gt} := 9$;Number of supporting timbers under a 20ft gantry track (min)

$N_{supt\_timbers} := 4$;Number of supporting timbers under gantry leg load. Timbers spaced at 30" centers. Therefore a single gantry leg contact will transer to approx. (4x) timbers at any time. Use (4) to be conservative.

$W_{6x8} := 12.5\frac{lbf}{ft} \cdot L_{timber} = 0.050\,kip$;Weight of a 6x8 timber

$W_{mat} := 3200lbf$;Weight of a 1ft x 4ft x 20ft crane mat

$R_{base} := P_g + W_g = 163.8 \cdot kip$;Reaction at base of gantry leg

Check timber bearing:

$P_{timber} := \frac{R_{base} + W_{gt}}{N_{supt\_timbers}} = 42.3 \cdot kip$;Load to a single timber

$A_{timber\_contact} := N_{supt\_timbers} \cdot b_{timber} \cdot 2 \cdot b_{f\_track} = 5.0 \cdot ft^2$;Timber top bearing area

$q_{timber} := \frac{P_{timber}}{A_{timber\_contact}} = 58.8 \cdot psi$;Timber compression perpendicular to grain

$Q_{allow\_timber} := 800psi$;Timber allowable: compression perpendicular to grain

$\boxed{\frac{q_{timber}}{Q_{allow\_timber}} = 0.07}$;Strength Ratio of crushing

Ground Bearing:

$P_{ground} := R_{base} + \left(W_{6x8} \cdot 4\right) + \frac{W_{mat}}{2} = 165.6 \cdot kip$;Load to ground over effective contact area

$L_{bearing} := [30in + (2) \cdot 3.75in + (2) \cdot 12in] \cdot 2 = 10.3 \cdot ft$ $W_{bearing} := 4ft$ $A_{bearing} := L_{bearing} \cdot W_{bearing} = 41.0 \cdot ft^2$

$\boxed{q := \frac{P_{ground}}{A_{bearing}} = 4.04 \cdot ksf}$;Ground bearing pressure capacity required by others

American Integrated Services, Inc.

Attachment C

Sigma Engineering Evaluation

P.O. Box 92316, Long Beach, CA 90809-2316 • 1502 E. Opp St., Wilmington, CA 90744-3927
Phone: 310.522.1168 • 888.423.6060 • Fax 310-522-0474
www.americanintegrated.com • Contractors License #757133

SIGMA ENGINEERING SOLUTIONS, INC.

December 5, 2016

Mr. Josh Whittaker
American Integrated Services, Inc.
1502 East Opp Street
Wilmington, California 90744

RE: Exide Technologies Deconstruction, Vernon CA
Kettle Removal

Dear Mr. Whittaker:

Per your request, Sigma Engineering Solutions, Inc. has reviewed the kettle structures for their structural integrity and ability to be removed from the current location within the Smelter Gallery. This analysis and design work was performed in reference to Sections 2.1 Items 6 and 7 of the letter regarding *"Discussion of "Mechanical Kettle Removal – Gantry System Method"* by Mr. Matt Wetter, PE QEP of the Department of Toxic Substance Control dated November 29, 2016. In addition, we examined the loading conditions present during the removal and the effects on the stability of the subterranean gallery walls as well as the ground capacity to support the gantry system. Details of these studies are presented in the calculation package accompanying this letter.

With regards to Section 2.1, Item 5, Sigma has determined that the ground bearing pressures encountered during a maximum possible lift of 152 tons using the equipment and procedures provided by Bigge Crane and Rigging Co. are within the foundation design recommendations provided by Dames and Moore in their report of May 5, 1980. This geotechnical report contains analysis of soils samples taken in the immediate vicinity of the kettle gallery making this report relevant. In addition, preliminary information from current sampling operations indicate the soil makeup is consistent with the previous report.

Secondly, Sigma investigated the integrity of the gallery walls during the lifting conditions described above. Three conditions were studied to determine the influence of the maximum possible lift on the wall stability. The results of all three conditions indicate the wall to be capable of performing as designed. In addition, supplementary vertical support is provided along the gantry travel path on the west side within a subterranean access tunnel near gridline 8. Two rows of four shoring posts with steel wide flange headers permit the gantry to travel unimpeded across the tunnel. A second tunnel exists at gridline 3; however, the current extraction plan does not involve this area.

With regards to Section 2.1, Item 6, Sigma conducted a three-dimensional finite element analysis of the kettle structures to determine their adequacy to withstand the forces encountered during the extraction. Using the provided as-built drawings which indicate the use of ASTM A516-70 material, Sigma has concluded that the kettles are capable of withstanding the forces induced from a completely full kettle (152 tons). In addition, the welds attaching the gusseted lifting points to the kettle structure meet the necessary strength requirements for the maximum possible lift. Since all gussets are of identical material, dimension and attachment, the opportunity exists to incorporate more gussets into a contingency plan that involves additional lifting points by simply drilling holes through the chosen gussets. Doing so would decrease the forces on each gusset under the maximum possible lift.

Lastly, it is worth mentioning that there are two factors that demonstrate the conclusions derived from these analyses to be relatively conservative:

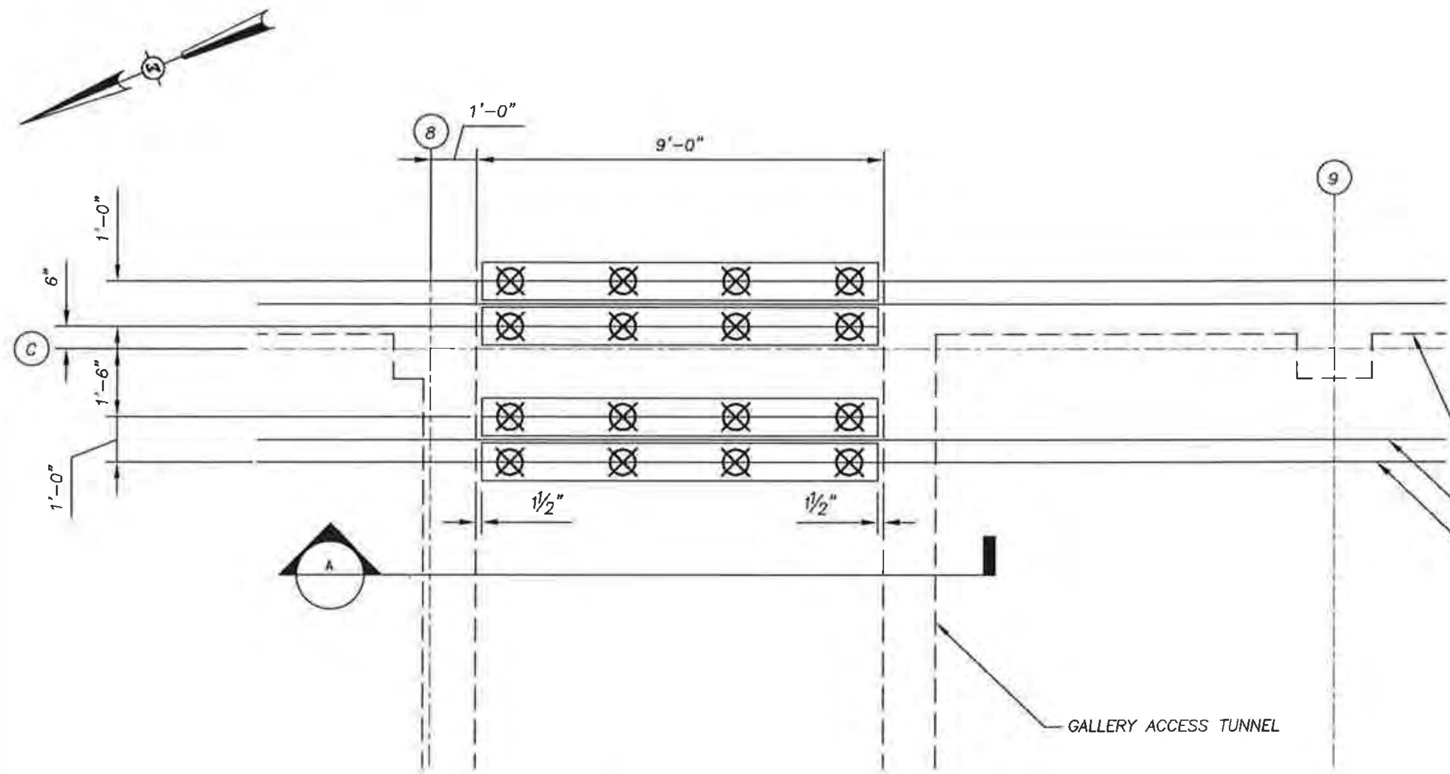
- Ground pressure calculations did not take into account the beneficial effect of the concrete slab-on-grade which would result in lower ground surcharge pressures adjacent to the walls.
- All calculations were prepared for a maximum possible lift of 152 tons; the fullest kettle is estimated to contain 100 tons of lead, plus an approximate kettle self-weight of 10 tons.

These two factors in combination provide additional factors of safety when considering the overall capacity of the existing conditions.

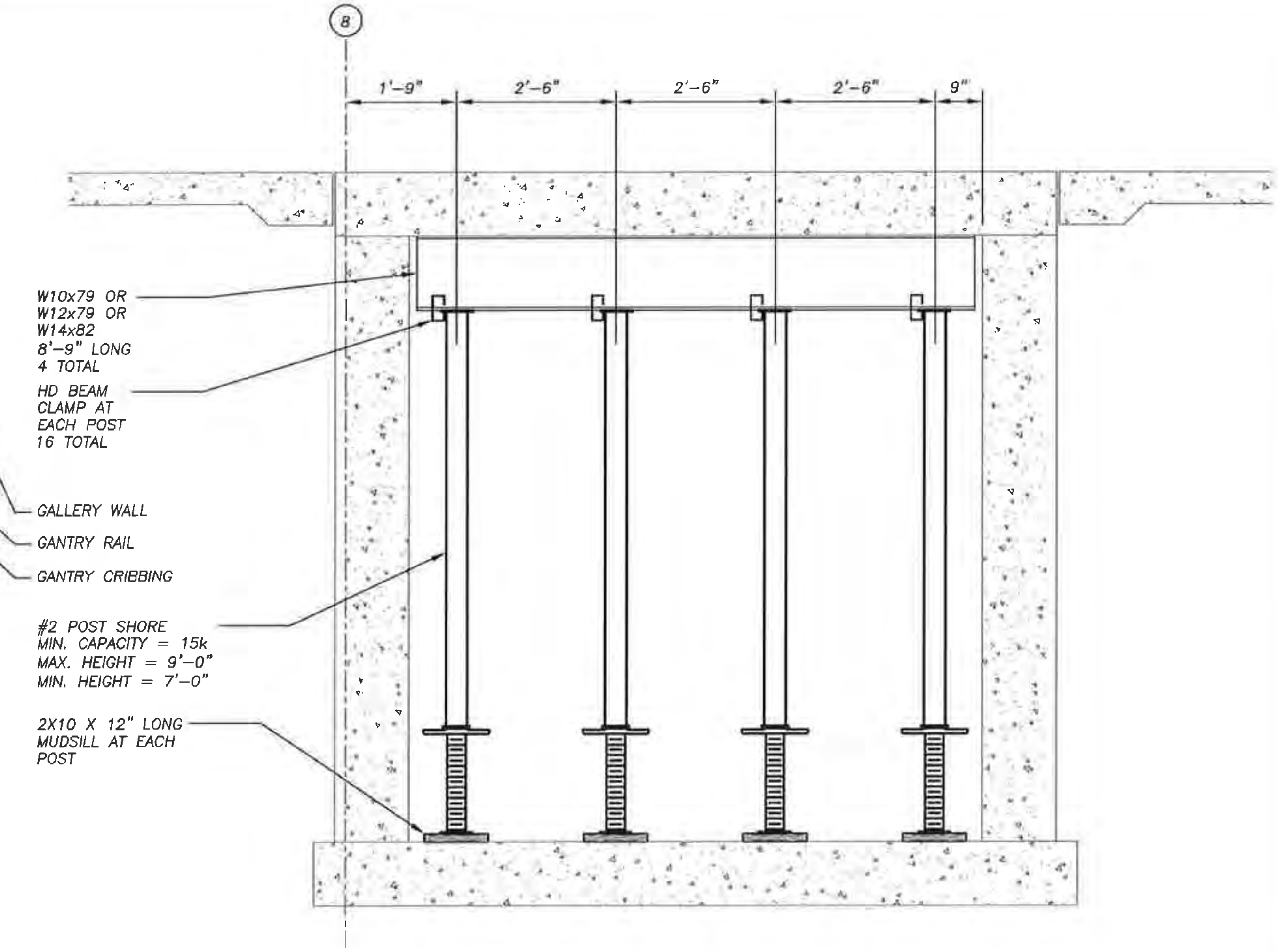
If you have any questions regarding this information, please feel free to call me at (702) 247-4462, or e-mail me at JFarre@SigmaNV.com.

Sincerely,

Joseph E. Farré, P.E.
President
Sigma Engineering Solutions, Inc.



1 SHORING LAYOUT - PLAN
SCALE: 1/2 = 1'-0"



A SHORING LAYOUT - ELEVATION
SCALE: 3/4" = 1'-0"

GENERAL SHORING NOTES:

1. THESE PLANS ARE LIMITED TO LAYOUT OF SHORING REQUIRED ONLY.
2. MINIMUM SPECIFIED SHORING POST CAPACITY SHALL BE BASED ON A SAFE WORKING LOAD WITH A FACTOR OF SAFETY = 3.0.
3. MIN. SINGLE POST SHORE CAPACITY = 15 KIPS
4. CONTRACTOR SHALL CHECK AND SECURE ALL ELEMENTS OF THE SHORING SYSTEM EVERY WORK DAY BEFORE THE START OF CRANE OPERATING HOURS.

NO.	DATE	REVISIONS	BY	CK

CLIENT
American Integrated Services, Inc.
APPROVED
DATE

SIGMA ENGINEERING SOLUTIONS, INC.
6623 Schuster Street Las Vegas, NV 89118
WWW.SIGMANV.COM
PH. 702.247.4462 FAX 702.632.2838

DESIGNED KD | CHECKED JEF | DRAWN BC

REGISTERED PROFESSIONAL ENGINEER JOSEPH E. F... NO. 91983 EXP. 9-30-18 CIVIL STATE OF CALIFORNIA
12/7/16

EXIDE PLANT DECONSTRUCTION
VERNON, CALIFORNIA
SEGMENT 2
SUPPLEMENTARY VERTICAL ACCESS
GALLERY ACCESS TUNNEL

CONTRACT | DATE DECEMBER 6, 2016 | JOB 16_0350

SHEET SD-74
DRAWING NO. 1 OF 1
REVISION 0
SCALE N.T.S.

MECHANICAL KETTLE REMOVAL – GANTRY SYSTEM METHOD

EXIDE TECHNOLOGIES FACILITY STRUCTURE DECONSTRUCTION

Vernon, CA

Submittal Date:
December 7, 2016

Prepared for:

American Integrated Services, Inc.

Sigma Project No. 16_0350

Prepared By:

SIGMA ENGINEERING SOLUTIONS, INC.

6623 Schuster Street
Las Vegas, Nevada 89118

MECHANICAL KETTLE REMOVAL – GANTRY SYSTEM METHOD

EXIDE TECHNOLOGIES FACILITY STRUCTURE DECONSTRUCTION

Vernon, CA

Submittal Date:
December 6, 2016

Prepared for:

American Integrated Services, Inc.

Sigma Project No. 16_0350

Document Preparation:

This document has been prepared by me, or under the direct supervision of a Registered Professional Engineer licensed to practice in the State of California:

REGISTERED PROFESSIONAL ENGINEER
JOSEPH E. FARRE
No. C51983
Exp. 9/30/18
CIVIL
STATE OF CALIFORNIA

12/05/2016

Engineer in responsible charge of document: Joseph E. Farré, P.E.
California P.E. #51983

TABLE OF CONTENTS

PROJECT DESCRIPTION

This project consists of the removal of seven kettles containing lead used for the manufacture of lead-acid batteries. The kettles contain amounts of lead in quantities varying from 12-100 tons. Bigge Crane and Rigging will provide a gantry system capable of lifting and removing the kettles from the gallery and relocating them on-site for further reduction. Sigma Engineering Solutions, Inc. has reviewed the analysis and design documents provided by Bigge Crane to determine appropriate loads for evaluate of the ground capacity and existing subterranean gallery walls situated beneath the gantry setup locations. In addition, Sigma has analyzed the kettle structures to determine their ability to be lifted from the galleries with contents remaining.

REFERENCE DOCUMENTS

Information from the following documents contributed in the formation of our engineering opinion:

1. As built drawings of kettle construction and materials (V-D6-88) by Exide Corporation dated 1/16/2009.
2. Ground bearing pressure due to applied loads from gantry system by Bigge Crane and Rigging Co dated November 30, 2016:
    a. *Kettle Lift General Arrangement*
    b. *Gantry Assembly*
    c. *Track Assembly*
    d. *Gantry System Analysis*
3. Comparative geotechnical properties from previous investigations:
    a. *Report – Soils investigation, West Coast Smelter Facility, Vernon, CA – Requisition No. 12253, Contract No. 7515* by Dames and Moore, May 5, 1980.
    b. *North Yard Soil Removal and Confirmation* by Philip Freeman dated September 30, 1980.
4. Preliminary geotechnical properties currently underway:
    a. *Figure 2 – Soil Data Gap Work Plan Proposed Soil Borings* by Advanced GeoServices dated 6/9/2016.
    b. *Preliminary Boring Logs TB-111I and TB-112S* dated 11/23/2016.
5. As-built drawings of Kettle Gallery (DC-201, -202, -207) by Exide Corporation dated 6/3/80.

KETTLE ANALYSIS METHODOLOGY AND RESULTS

The seven kettle structures are constructed with 1-1/2” thick ASTM A516 Grade 70 plate. This material is typically used in pressure vessels and tanks containing materials with high temperatures. A 9-1/2” wide by 1-1/2” thick horizontal steel ring circumscribes the kettle 9 inches from the top edge. This ring is stiffened at 24 equidistant locations with a 1-1/2” thick triangular gusset welded to the plate and kettle. One gusset in each quadrant contains a 2” diameter hole used for rigging attachment points. The gussets are attached with full penetration welds on both vertical and horizontal edges.

The weight of the kettle itself is 16,220 lbs; a completely filled kettle can contain 286,178 lbs. of hardened lead. The total maximum possible lift is 302,398 lbs or 151.2 tons. The hoisting calculations were prepared using this maximum possible lift to determine member sizes and resulting resistance pressures. It is estimated that the fullest kettle contains 100+/- tons of lead providing a source of additional reserve capacity.

Sigma modelled the kettle using the three-dimensional finite element modelling/analysis program *Solidworks*. The kettle was modelled using the geometry provided by the as-built drawings (V-D6-88) and the material descriptions noted therein. Loads were applied at appropriate locations and magnitudes to generate resulting stresses, strains and reactions. Evaluation of these forces confirms the locations of highest stress to be in the attachment of triangular gussets to the kettle. The magnitude of the load producing these stresses using the maximum possible lift of 152 tons is approximately 38 kips which is less than the allowable load of 102.4 kip. Sigma also evaluated the strength of the welds attaching the gusset to the kettle and found them to be sufficient. Our opinion is that the kettles are amply capable of withstanding a maximum possible pick.

GROUND BEARING PRESSURE ANALYSIS AND RESULTS

Drawings and calculations provided by Bigge Crane and Rigging Co. were reviewed to determine loads imparted on the ground below the gantry picking locations. The loads used by Bigge considered worst case conditions encountered during the picks which place a higher concentration of load to one side of the system. A lateral load of 5% was chosen by Bigge to depict inertial forces anticipated during the lateral movement of kettle within the gantry. These collective loads were followed through the gantry system, the supporting rails and the sleeper assembly. The sleeper assembly used by Bigge is four feet wide.

Past geotechnical reports used for the design and construction of the facility were reviewed for recommended soil properties. The report by Dames and Moore dated May 5, 1980 for the construction of the Smelter facility recommends an allowable resisting soil pressure of 3,000 psf for spread footings with a minimum width of two feet. An additional 600 psf for each foot of width beyond two feet for a total allowable of 4,200 psf with a four-foot-wide bearing surface. A further increase of 33% increase is allowed for short term load peaks.

Per the Bigge calculations, the vertical forces encountered during the maximum possible static lift of 152 tons creates a ground pressure of 4,040 psf. This is less than the 4,200 psf allowable recommended by the Dames and Moore report. Our opinion is that the soil can support the maximum possible pick.

BASEMENT WALL ANALYSIS AND RESULTS

The kettles are in a subterranean gallery having a floor elevation approximately ten feet below slab on grade elevation. The setup of the gantry system places one wheel load directly over the basement wall with the other wheel load approximately three feet outside of the wall. This arrangement places the wall in vertical compression and lateral bending simultaneously from both the lateral earth pressures and the gantry surcharge. Forces used for the analysis were from the Bigge gantry calculations and the soil properties used to calculate the lateral earth pressures were from the Dames and Moore report. As-built drawings provided the concrete material and reinforcement properties.

The basement wall was analyzed for a static condition with the maximum possible lift of 152 tons as well as the combination of the maximum possible lift with overturning forces in each direction. Our analysis was conducted using in-house software that quantified the effects of the gantry system lateral surcharge adjacent to the wall combined with the vertical compression induced on the wall from the wheel loading located directly on the wall. Included in our analysis was an allowance for an accidental eccentricity of 12 inches which produces an amplified bending force on the basement wall. This allowance will cover tolerances in placement of the gantry system.

Upon examination of the results of all three cases, it is our opinion that the integrity of the basement wall is not compromised during the maximum possible lift.

TUNNEL SHORING

Existing tunnels providing subterranean access to the kettle gallery exists near grids C-3 and C-8. These below grade tunnels cross below the gantry travel path. Supplementary vertical shoring is required to provide a satisfactory path of travel during the extraction operation. With the current extraction plan, the gantry does not travel far enough to encounter the tunnel at C-3; thus, the tunnel at C-8 is our concern.

The tunnel is 9’-0 wide with a lid having a minimum thickness of 1’-0” per as-built drawing DC-207. The bottom reinforcement consists of #7 rebar spaced at twelve inches in the direction of the span. The controlling bending moment produced by the gantry consists of a single wheel load at mid span. The existing slab requires supplementary vertical supports in order to properly support the loads produced by the gantry legs.

Two rows of four shoring posts beneath each rail provide the required support. The shoring posts should be a Heavy Duty #2 post by Aluma Systems or equivalent. A wide flange beam with a minimum web thickness of ½” is required on each line of posts to assist with transferring the loads to the posts. The beam should be fastened to the posts with a heavy duty C-clamp on one side of each post. The maximum shored height is approximately 8’-0”. A total of four beams, 16 posts and 16 C-clamps are required. See drawing SD-74 for plans and details.

APPENDIX A

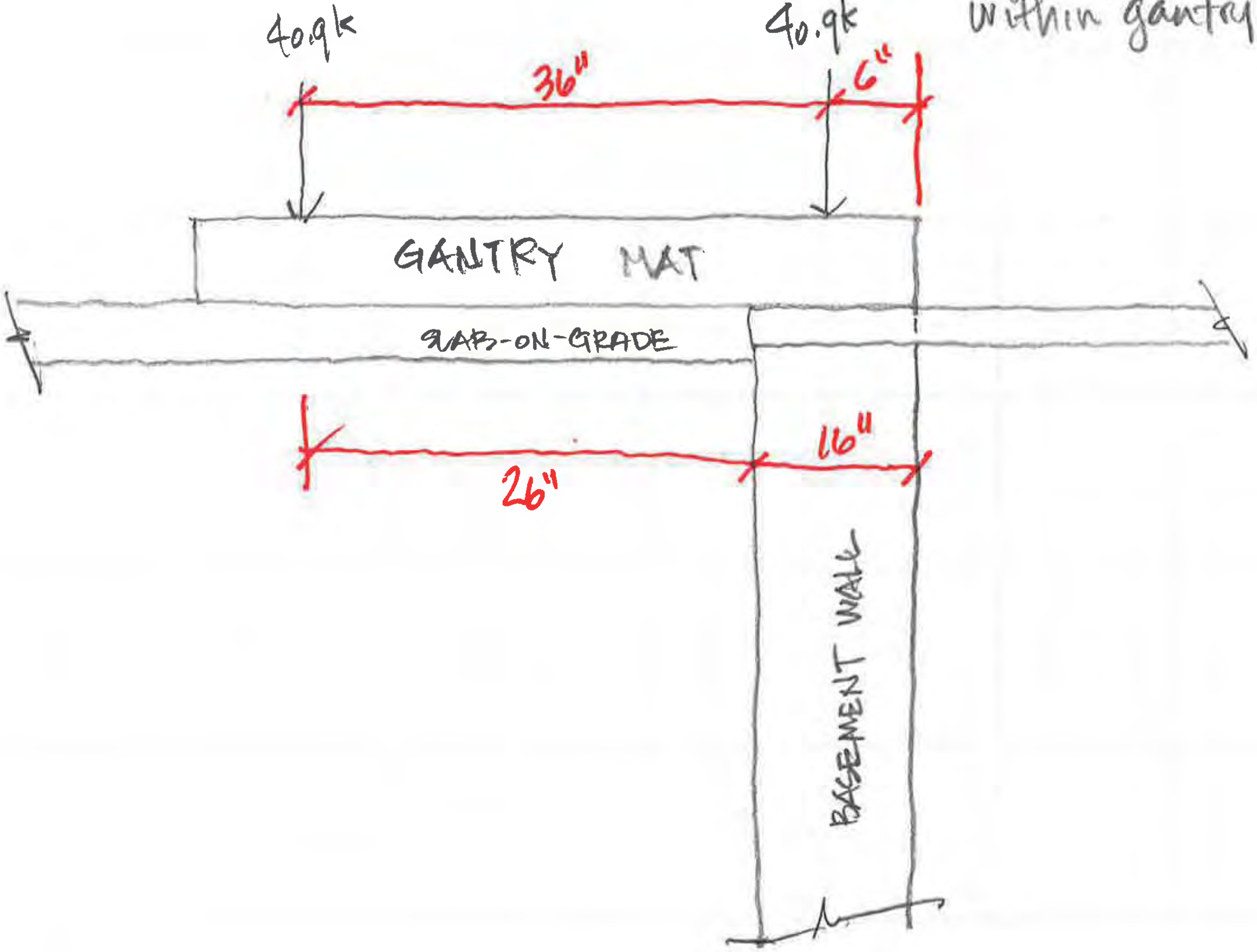
Supporting Calculations:

SIGMA ENGINEERING SOLUTIONS, INC.

Subject: Exide Technologies
Gantry System – Wall analysis

COMP. BY:
CHK. BY:
DATE:
SHEET NO.:
JOB NO.:

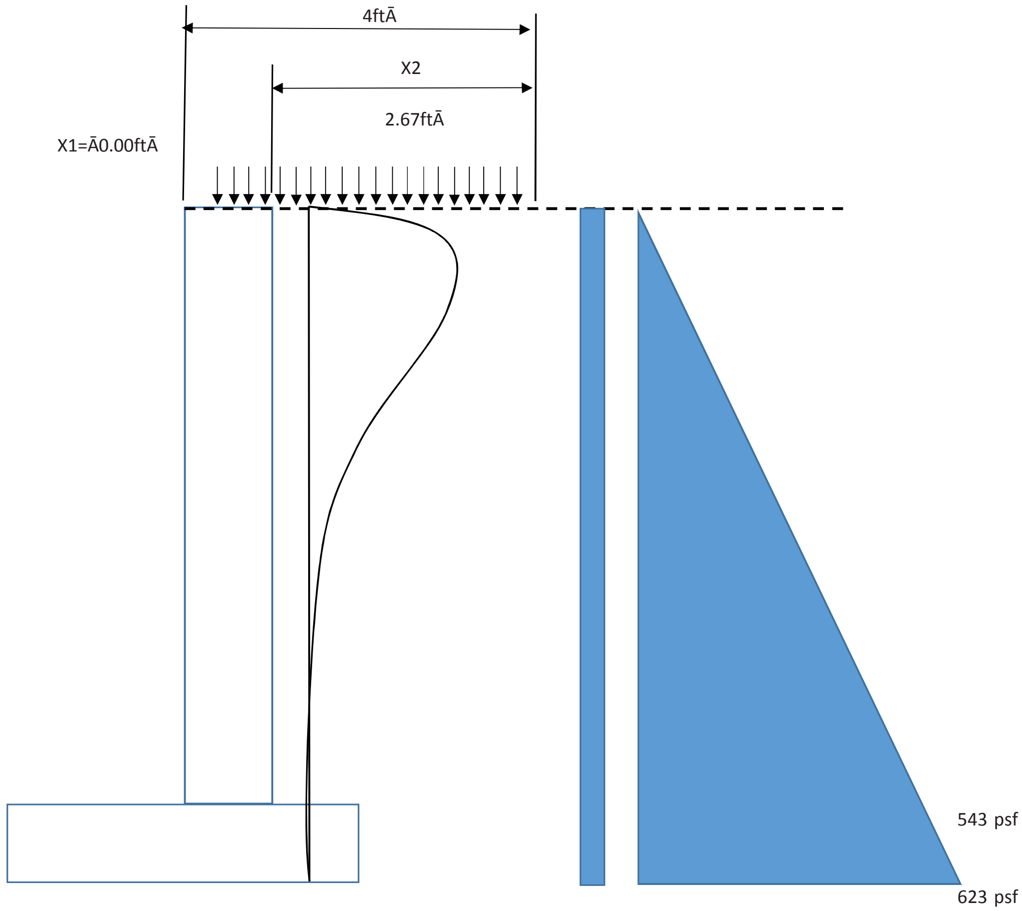
Condition 1: Static condition = max. lift equally distributed within gantry leg



ExamineeffectofGantrysurchageonwall

Location:ExideTechnologiesKettleGalleryĀĀĀĀĀĀĀ

			Adjusted ElevationsĀ
BackwallHeightĀ	0.000	ft	
StemHeightĀ	9.042	ft	9.041667 ft
FootingThicknessĀ	1.333	ft	1.333333 ft
TotalPressureHeightĀĀ	10.38	ft	
DroppedCraneMatDistanceĀĀĀ	0	ft	
AtrestSoilPressureBehindWall:ĀĀĀĀĀ	60	psf/ft	
CraneGroundPressure(Surcharge)ĀĀĀ	4212	psf	
DistancetoFrontofSurchageLoadĀĀĀĀĀ	0	ft	X1
DistancetoRearofLoadĀĀĀĀ	2.666667	ft	X2


4ftĀ
X2
2.67ftĀ
X1=Ā0.00ftĀ
543 psf
623 psf

DesignForces

HorizontalSoilPressureatBottomofFtgĀĀĀĀĀĀ	622.5	psf		
TotalEstimatedLateralLoadDuetoactiveSoilPressureĀĀĀĀĀĀĀĀ	6458	lbs		
TotalEstimatedLateralLoadDuetoGantrysurchargeĀĀĀĀĀĀĀ	6829	lbs	54.3	kftĀ
SurchargeLoadsat10.38ftbelowbackfillheightĀĀĀĀĀĀĀ				
TotalEstimatedLateralLoadĀĀĀ	13.29	kips		
TotalEstimatedOTMatBOFĀĀĀĀ	76.6	KipftĀ		

StemCheckĀ

HorizontalSoilPressureatBottomofStemĀĀĀĀĀĀ	542.5	psf		
TotalEstimatedLateralĀLoadDuetoactiveSoilPressureĀĀĀĀĀĀ	4905	lbs		
TotalEstimatedLateralLoadDuetoGantrysurchargeĀĀĀĀĀĀĀ	6763	lbs	47.5	kftĀ
SurchargeLoadsat9.04ftbelowbackfillheightĀĀĀĀĀĀĀ				
TotalEstimatedLateralLoadĀĀĀ	11.67	kips		
TotalEstimatedOTMatBOFĀĀĀĀ	62.3	KipftĀ		

Total SurchargeĀWt.	40950	lbs	CraneLoĀad
WidthoĀfCrĀane Pad	3.64583	ft	as measuredĀparallel toĀwall = 1/2whĀeelbĀaseoĀf1ĀgaĀntrylegĀ
Length ofCrĀanePaĀd	2.66667	ft	asmeasĀuredPerpendiĀcularfromwĀĀall face
Equiv. Unif. CraneĀSurcha	4212	psf	

H	Vertical Surcharge Pressure	Distance"SĀ'asmĀĀasured fromBackfaceoĀĀWalltoCenĀĀerofSĀĀrchageLoadĀ 2.1667 S =2Ā X_1	2.1667 S=2ĀĀ X_2	2.1667 S =2Ā θ_1	2.1667 S=2ĀĀ θ_2	2.1667 S =2Ā β	2.1667 S=2ĀĀ α	2.16667 Ps	2.166667 R_x Lbs	2.166667 Z_BAR	2.166666667 M lb-ft
0.0	4212	0.83	3.50	90.00	90.00	0.00	90.00	0.00	0	-2558	0
0.5	4212	0.83	3.50	59.04	81.87	22.83	70.45	1876.20	534	0.32	94
1	4212	0.83	3.50	39.81	74.05	34.25	56.93	2213.29	1,603	0.61	622
1.5	4212	0.83	3.50	29.05	66.80	37.75	47.93	1934.03	2,650	0.86	1,691
2	4212	0.83	3.50	22.62	60.26	37.64	41.44	1558.24	3,523	1.08	3,242
2.5	4212	0.83	3.50	18.43	54.46	36.03	36.45	1222.26	4,215	1.27	5,183
3	4212	0.83	3.50	15.52	49.40	33.87	32.46	951.87	4,756	1.44	7,432
3.5	4212	0.83	3.50	13.39	45.00	31.61	29.20	742.70	5,177	1.58	9,919
4	4212	0.83	3.50	11.77	41.19	29.42	26.48	583.29	5,507	1.71	12,594
4.5	4212	0.83	3.50	10.49	37.87	27.38	24.18	462.18	5,767	1.83	15,415
5	4212	0.83	3.50	9.46	34.99	25.53	22.23	369.88	5,974	1.93	18,352
5.5	4212	0.83	3.50	8.62	32.47	23.86	20.54	299.07	6,140	2.02	21,382
6	4212	0.83	3.50	7.91	30.26	22.35	19.08	244.27	6,276	2.10	24,487
6.5	4212	0.83	3.50	7.31	28.30	20.99	17.80	201.46	6,387	2.17	27,654
7	4212	0.83	3.50	6.79	26.57	19.78	16.68	167.70	6,479	2.24	30,871
7.5	4212	0.83	3.50	6.34	25.02	18.68	15.68	140.81	6,556	2.29	34,130
8	4212	0.83	3.50	5.95	23.63	17.68	14.79	119.20	6,620	2.35	37,424
8.5	4212	0.83	3.50	5.60	22.38	16.78	13.99	101.67	6,675	2.40	40,748
9	4212	0.83	3.50	5.29	21.25	15.96	13.27	87.32	6,723	2.44	44,098
9.5	4212	0.83	3.50	5.01	20.22	15.21	12.62	75.49	6,763	2.48	47,470
10	4212	0.83	3.50	4.76	19.29	14.53	12.03	65.66	6,798	2.52	50,860
10.5	4212	0.83	3.50	4.54	18.43	13.90	11.49	57.44	6,829	2.55	54,267
11	4212	0.83	3.50	4.33	17.65	13.32	10.99	50.50	6,856	2.59	57,689
11.5	4212	0.83	3.50	4.14	16.93	12.78	10.54	44.62	6,880	2.62	61,123
12	4212	0.83	3.50	3.97	16.26	12.29	10.12	39.61	6,901	2.64	64,568
12.5	4212	0.83	3.50	3.81	15.64	11.83	9.73	35.31	6,919	2.67	68,023
13	4212	0.83	3.50	3.67	15.07	11.40	9.37	31.60	6,936	2.69	71,487
13.5	4212	0.83	3.50	3.53	14.53	11.00	9.03	28.39	6,951	2.72	74,959
14	4212	0.83	3.50	3.41	14.04	10.63	8.72	25.59	6,965	2.74	78,438
14.5	4212	0.83	3.50	3.29	13.57	10.28	8.43	23.15	6,977	2.76	81,924
15	4212	0.83	3.50	3.18	13.13	9.95	8.16	21.00	6,988	2.78	85,415

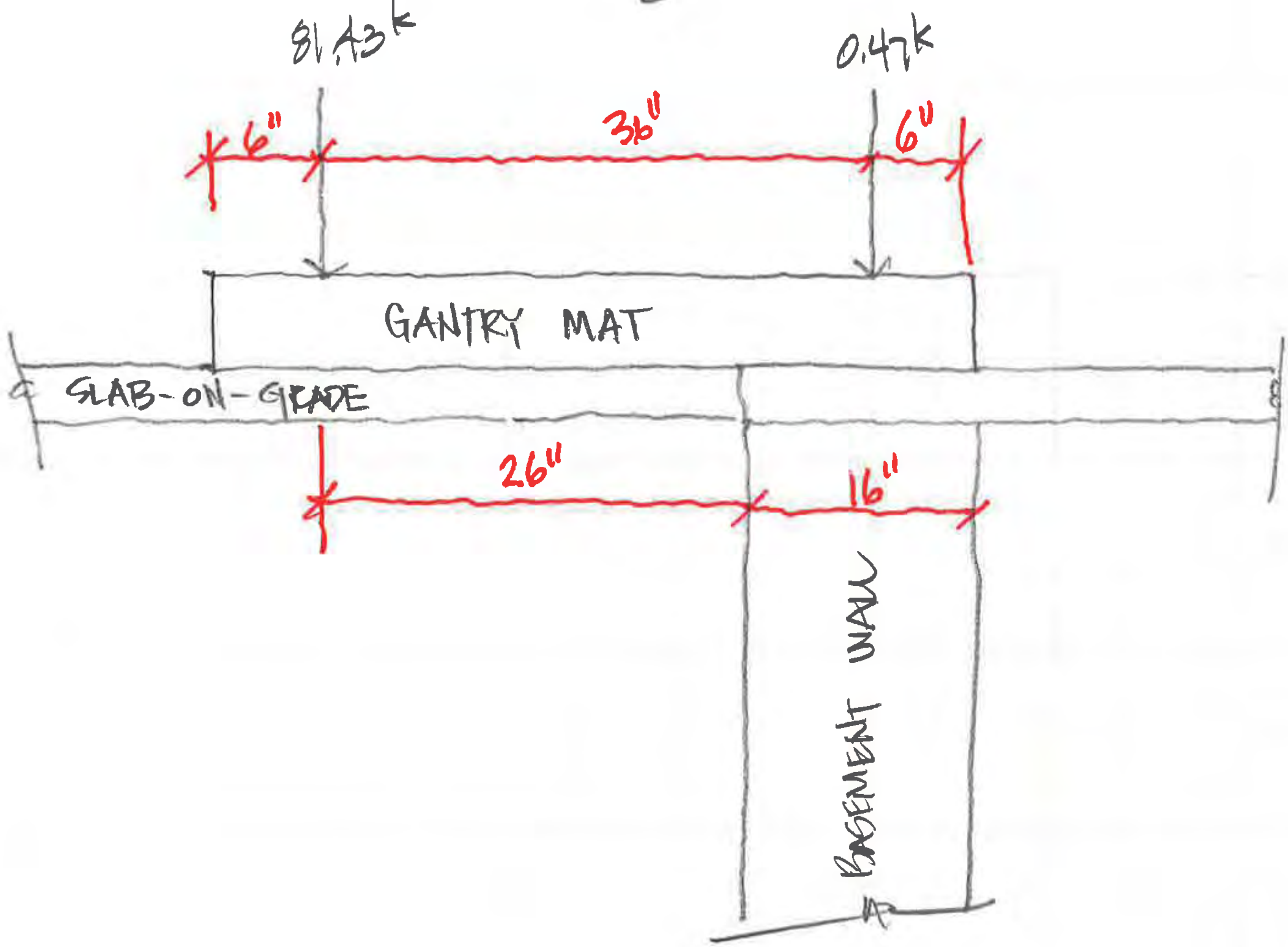
Wheel load	40,950	lbs	
Pu	57,330	lbs	
Anticipated eccentricity	12	in	
Check wall slenderness			
K	1		
lu	118	in	
h	16	in	
r	4.8	in	
Kl_u/r	24.6	<	100
Calculate magnified moments in non-sway condition			
E	3,372,165	psi	
I	14,763	in4	
Pc	813,002,530	lbs	
Cm	1		
dns	1.0		
f'c	3.5	ksi	
fy	60	ksi	
BarsizeĀ	#8		
BarspacingĀ	10	in	
As	3.46	in2/ft	
b	43.75	in	
h	16	in	
cover	2.5	in	
d	13	in	
a	1.59	in	
φMn	189.8	kft/ftĀ	
φVc	57.2	k	
Mu	90.9	kft/ftĀ	<fMn=OĀĀKĀ
Vu	11.7	k	<fVn=OĀĀKĀ

SIGMA ENGINEERING SOLUTIONS, INC.

COMP. BY: KG
CHK. BY:
DATE: 12/2/2016
SHEET NO.:
JOB NO.:

Subject: Exide technologies
Gantry system - wall analysis

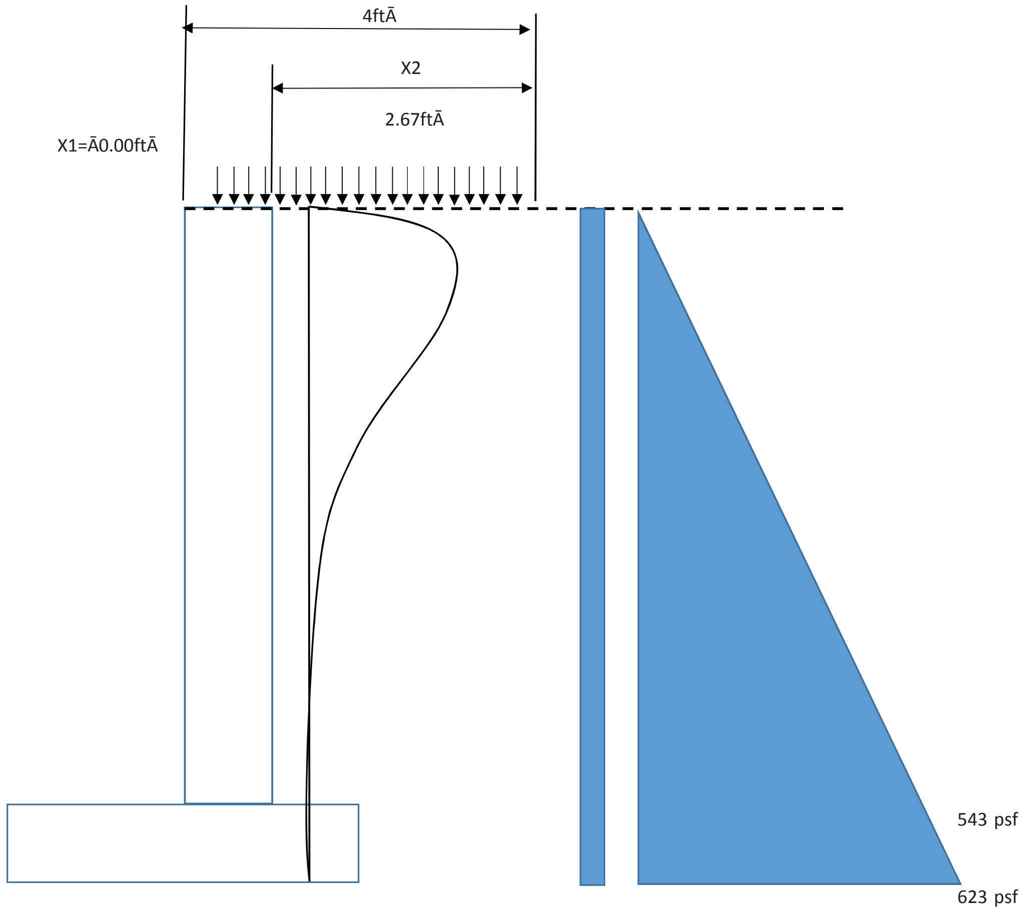
Condition 2: Max. overturning on surcharge



ExamineeffectofGantrysurchageonwall

Location:ExideTechnologiesKettleGalleryĀĀĀĀĀĀĀ

			AdjustedElevationsĀ
BackwallHeightĀ	0.000	ft	
StemHeightĀ	9.042	ft	9.041667 ft
FootingThicknessĀ	1.333	ft	1.333333 ft
TotalPressureHeightĀĀ	10.38	ft	
DroppedCraneMatDistanceĀĀĀ	0	ft	
ActiveSoilPressureBehindWall:ĀĀĀĀ	60	psf/ft	
CraneGroundPressure(Surcharge)ĀĀĀ	8376	psf	
DistancetoFrontofSurchageLoadĀĀĀĀĀ	0	ft	X1
DistancetoRearofLoadĀĀĀĀ	2.666667	ft	X2


4ftĀ
X2
2.67ftĀ
X1=Ā0.00ftĀ
543 psf
623 psf

DesignForces

HorizontalSoilPressureatBottomofFtgĀĀĀĀĀĀ	622.5	psf		
TotalEstimatedLateralLoadDuetoactiveSoilPressureĀĀĀĀĀĀĀĀ	6458	lbs		
TotalEstimatedLateralLoadDuetoGantrysurchargeĀĀĀĀĀĀĀ	13580	lbs	107.9	kftĀ
SurchargeLoadsat10.38ftbelowbackfillheightĀĀĀĀĀĀĀ				
TotalEstimatedLateralLoadĀĀĀ	20.04	kips		
TotalEstimatedOTMatBOFĀĀĀĀ	130.2	KipftĀ		

StemCheckĀ

HorizontalSoilPressureatBottomofStemĀĀĀĀĀĀ	542.5	psf		
TotalEstimatedLateralĀLoadDuetoactiveSoilPressureĀĀĀĀĀĀ	4905	lbs		
TotalEstimatedLateralLoadDuetoGantrysurchargeĀĀĀĀĀĀĀ	13449	lbs	94.4	kftĀ
SurchargeLoadsat9.04ftbelowbackfillheightĀĀĀĀĀĀĀ				
TotalEstimatedLateralLoadĀĀĀ	18.35	kips		
TotalEstimatedOTMatBOFĀĀĀĀ	116.6	KipftĀ		

Total SurchargeĀWt.	81430	lbs	CraneLoĀad
WidthoĀfCrĀane Pad	3.64583	ft	as measuredĀparallel toĀwall = 1/2whĀeelbĀaseoĀf1ĀgaĀntrylegĀ
Length ofCrĀanePaĀd	2.66667	ft	asmeasĀuredPerpendiĀcularfromwĀĀll face
Equiv. Unif. CraneĀSurcha	8376	psf	

H	Vertical Surcharge Pressure	Distance"SĀ"asmĀĀasured fromBackfaceoĀĀWalltoCenĀĀerofSĀurchageLoadĀ									
		2.1667	2.1667	2.1667	2.1667	2.1667	2.1667	2.16667	2.166667	2.166667	2.166666667
		S =2Ā	S=2ĀĀ	S =2Ā	S=2ĀĀ	S =2Ā	S=2ĀĀ	Ps	R_x	Z_BAR	M
		X_1	X_2	θ_1	θ_2	β	α		Lbs		lb-ft
0.0	8376	0.83	3.50	90.00	90.00	0.00	90.00	0.00	0	-2558	0
0.5	8376	0.83	3.50	59.04	81.87	22.83	70.45	3730.87	1,062	0.32	187
1	8376	0.83	3.50	39.81	74.05	34.25	56.93	4401.18	3,187	0.61	1,236
1.5	8376	0.83	3.50	29.05	66.80	37.75	47.93	3845.87	5,269	0.86	3,362
2	8376	0.83	3.50	22.62	60.26	37.64	41.44	3098.59	7,005	1.08	6,446
2.5	8376	0.83	3.50	18.43	54.46	36.03	36.45	2430.50	8,382	1.27	10,307
3	8376	0.83	3.50	15.52	49.40	33.87	32.46	1892.82	9,457	1.44	14,778
3.5	8376	0.83	3.50	13.39	45.00	31.61	29.20	1476.87	10,295	1.58	19,725
4	8376	0.83	3.50	11.77	41.19	29.42	26.48	1159.88	10,951	1.71	25,043
4.5	8376	0.83	3.50	10.49	37.87	27.38	24.18	919.05	11,468	1.83	30,652
5	8376	0.83	3.50	9.46	34.99	25.53	22.23	735.52	11,879	1.93	36,493
5.5	8376	0.83	3.50	8.62	32.47	23.86	20.54	594.70	12,210	2.02	42,518
6	8376	0.83	3.50	7.91	30.26	22.35	19.08	485.73	12,479	2.10	48,693
6.5	8376	0.83	3.50	7.31	28.30	20.99	17.80	400.62	12,700	2.17	54,990
7	8376	0.83	3.50	6.79	26.57	19.78	16.68	333.48	12,883	2.24	61,387
7.5	8376	0.83	3.50	6.34	25.02	18.68	15.68	280.01	13,036	2.29	67,868
8	8376	0.83	3.50	5.95	23.63	17.68	14.79	237.03	13,165	2.35	74,419
8.5	8376	0.83	3.50	5.60	22.38	16.78	13.99	202.17	13,274	2.40	81,029
9	8376	0.83	3.50	5.29	21.25	15.96	13.27	173.64	13,368	2.44	87,690
9.5	8376	0.83	3.50	5.01	20.22	15.21	12.62	150.12	13,449	2.48	94,395
10	8376	0.83	3.50	4.76	19.29	14.53	12.03	130.57	13,519	2.52	101,137
10.5	8376	0.83	3.50	4.54	18.43	13.90	11.49	114.21	13,580	2.55	107,912
11	8376	0.83	3.50	4.33	17.65	13.32	10.99	100.43	13,633	2.59	114,716
11.5	8376	0.83	3.50	4.14	16.93	12.78	10.54	88.74	13,681	2.62	121,544
12	8376	0.83	3.50	3.97	16.26	12.29	10.12	78.77	13,722	2.64	128,395
12.5	8376	0.83	3.50	3.81	15.64	11.83	9.73	70.21	13,760	2.67	135,266
13	8376	0.83	3.50	3.67	15.07	11.40	9.37	62.84	13,793	2.69	142,154
13.5	8376	0.83	3.50	3.53	14.53	11.00	9.03	56.45	13,823	2.72	149,058
14	8376	0.83	3.50	3.41	14.04	10.63	8.72	50.89	13,849	2.74	155,976
14.5	8376	0.83	3.50	3.29	13.57	10.28	8.43	46.03	13,874	2.76	162,907
15	8376	0.83	3.50	3.18	13.13	9.95	8.16	41.76	13,895	2.78	169,849

Wheel load	470	lbs	
Pu	658	lbs	
Anticipated eccentricity	12	in	
Check wall slenderness			
K	1		
lu	118	in	
h	16	in	
r	4.8	in	
Kl_u/r	24.6	<	100
Calculate magnified moments in non-sway condition			
E	3,372,165	psi	
I	14,763	in4	
Pc	813,002,530	lbs	
Cm	1		
dns	1.0		
f'c	3.5	ksi	
fy	60	ksi	
BarsizeĀ	#8		
BarspacingĀ	10	in	
As	3.46	in2/ft	
b	43.75	in	
h	16	in	
cover	2.5	in	
d	13	in	
a	1.59	in	
φMn	189.8	kft/ftĀ	
φVc	57.2	k	
Mu	116.9	kft/ftĀ	<fMn=OĀĀKĀ
Vu	18.4	k	<fVn=OĀĀKĀ

SIGMA ENGINEERING SOLUTIONS, INC.

COMP. BY: bd

CHK. BY:

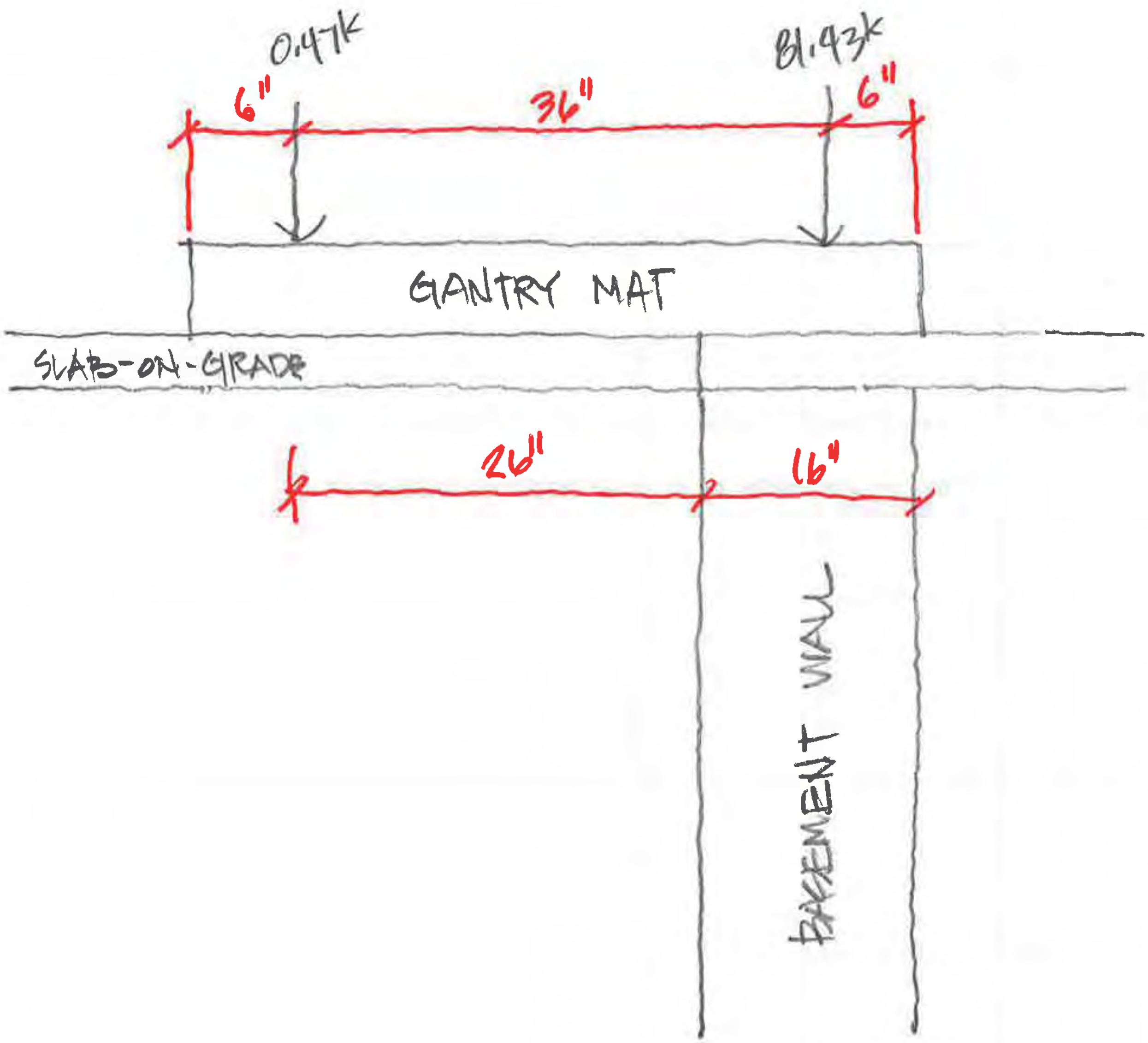
DATE: 12/2/2016

SHEET NO.:

JOB NO.:

Subject: EXIDE TECHNOLOGIES
GANTRY SYSTEM – WALL ANALYSIS

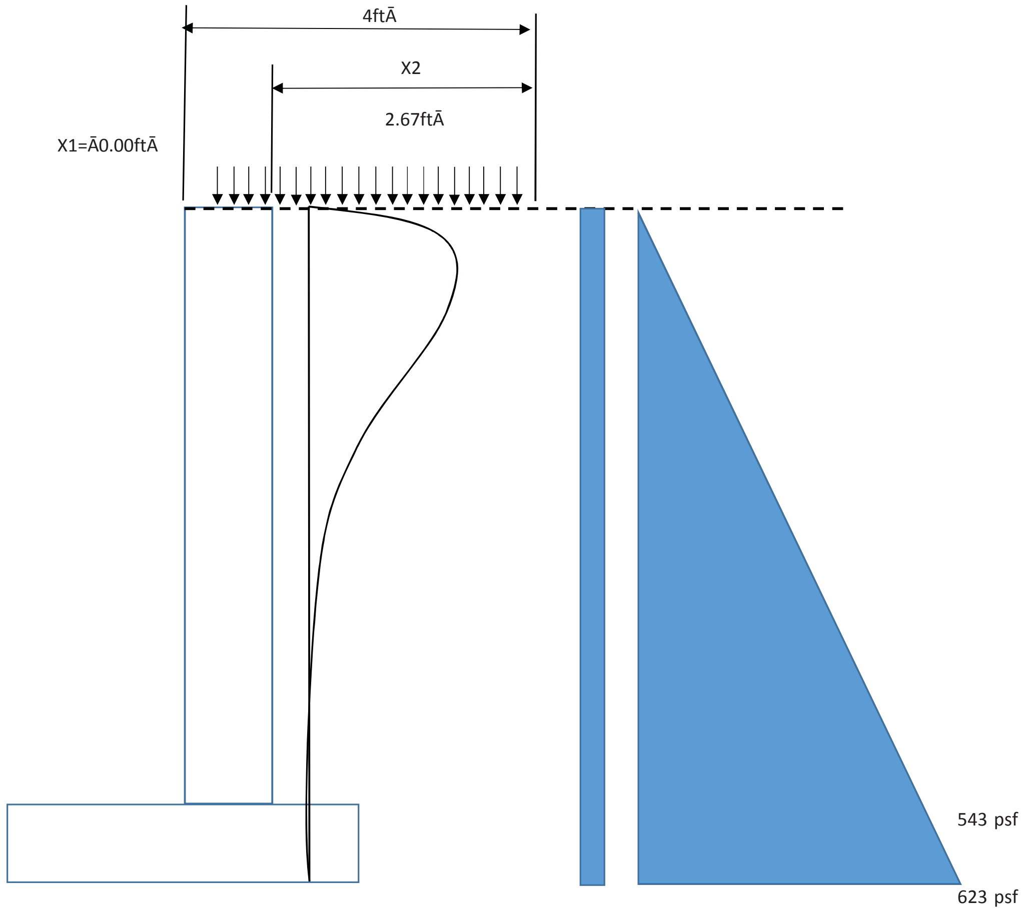
Condition 3: Max. overturning on wall.



ExamineeffectofGantrysurchageonwall

Location:ExideTechnologiesKettleGalleryĀĀĀĀĀĀĀ

			AdjustedElevationsĀ
BackwallHeightĀ	0.000	ft	
StemHeightĀ	9.042	ft	9.041667 ft
FootingThicknessĀ	1.333	ft	1.333333 ft
TotalPressureHeightĀĀ	10.38	ft	
DroppedCraneMatDistanceĀĀĀ	0	ft	
ActiveSoilPressureBehindWall:ĀĀĀĀ	60	psf/ft	
CraneGroundPressure(Surcharge)ĀĀĀ	48	psf	
DistancetoFrontofSurchageLoadĀĀĀĀĀ	0	ft	X1
DistancetoRearofLoadĀĀĀĀ	2.666667	ft	X2


4ftĀ
X2
2.67ftĀ
X1=Ā0.00ftĀ
543 psf
623 psf

DesignForces

HorizontalSoilPressureatBottomofFtgĀĀĀĀĀĀ 622.5 psf

TotalEstimatedLateralLoadDuetoactiveSoilPressureĀĀĀĀĀĀĀĀ 3229 lbs

TotalEstimatedLateralLoadDuetoGantrysurchargeĀĀĀĀĀĀĀ 78 lbs 0.6 kftĀ

SurchargeLoadsat10.38ftbelowbackfillheightĀĀĀĀĀĀĀ

TotalEstimatedLateralLoadĀĀĀ 3.31 kips

TotalEstimatedOTMatBOFĀĀĀĀ 17.4 KipftĀ

StemCheckĀ

HorizontalSoilPressureatBottomofStemĀĀĀĀĀĀ 542.5 psf

TotalEstimatedLateralĀLoadDuetoactiveSoilPressureĀĀĀĀĀĀ 2453 lbs

TotalEstimatedLateralLoadDuetoGantrysurchargeĀĀĀĀĀĀĀ 78 lbs 0.5 kftĀ

SurchargeLoadsat9.04ftbelowbackfillheightĀĀĀĀĀĀĀ

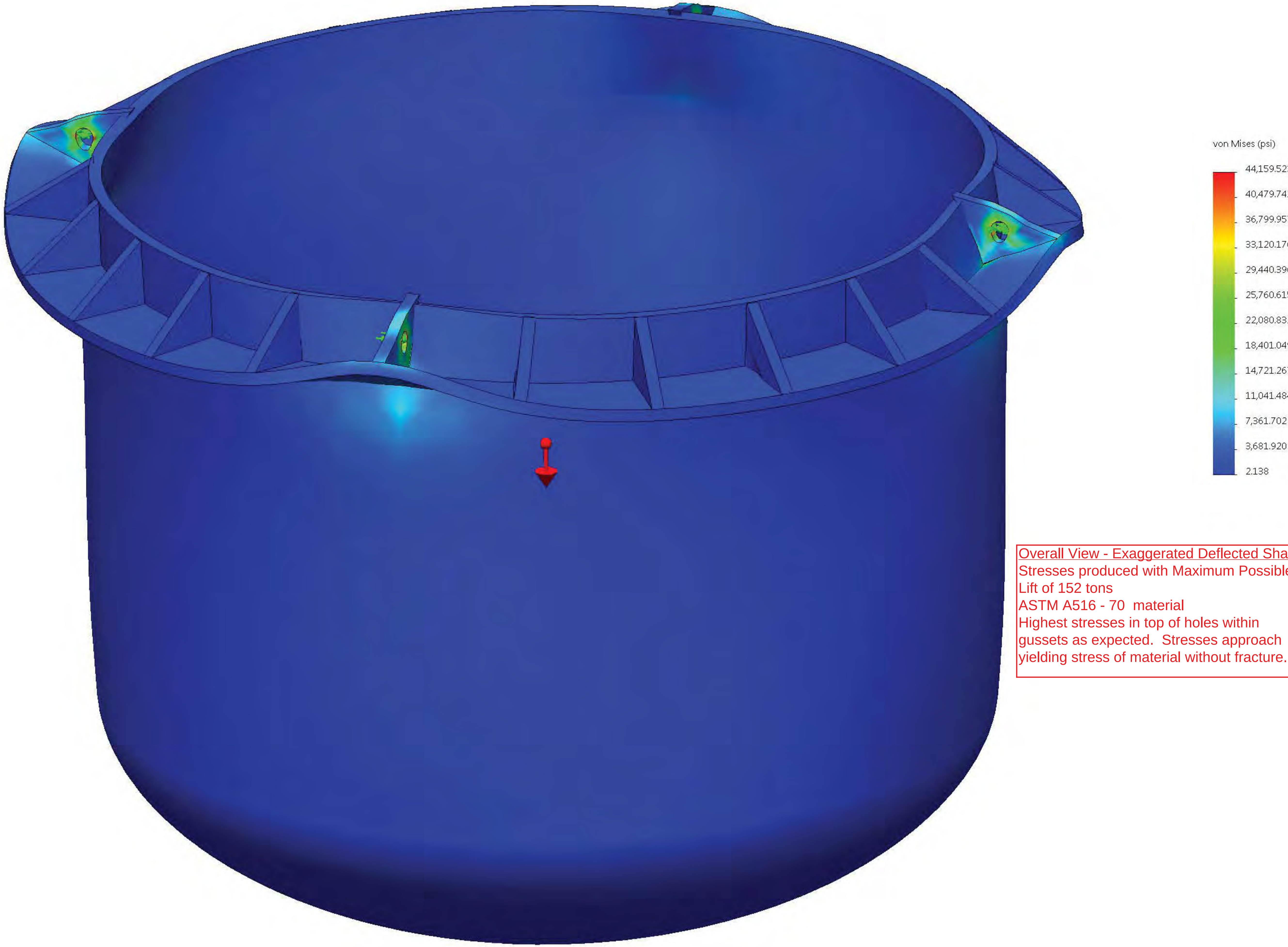
TotalEstimatedLateralLoadĀĀĀ 2.53 kips

TotalEstimatedOTMatBOFĀĀĀĀ 11.6 KipftĀ

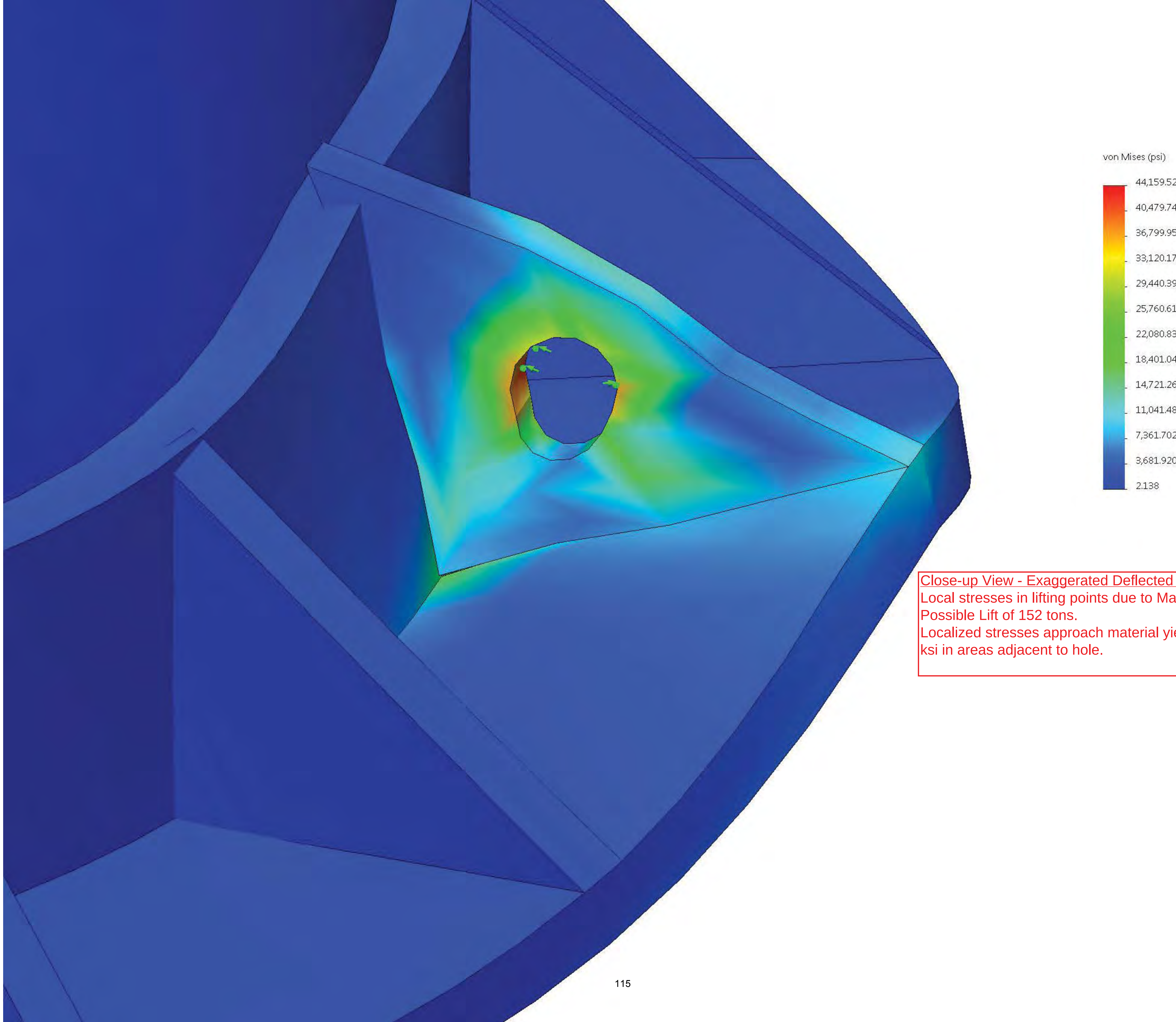
Total SurchargeĀWt.	470	lbs	CraneLoĀad
WidthoĀfCrĀane Pad	3.64583	ft	as measuredĀparallel toĀwall = 1/2whĀeelbĀaseoĀf1ĀgaĀntrylegĀ
Length ofCrĀanePaĀd	2.66667	ft	asmeasĀuredPerpendiĀcularfromwĀĀall face
Equiv. Unif. CraneĀSurcha	48	psf	

H	Vertical Surcharge Pressure	Distance"SĀ"asmĀĀeasured fromBackfaceoĀĀWalltoCenĀĀterofSĀurchargeLoadĀ 2.1667 S =2Ā X_1	2.1667 S=2ĀĀ X_2	2.1667 S =2Ā θ_1	2.1667 S=2ĀĀ θ_2	2.1667 S =2Ā β	2.1667 S=2ĀĀ α	2.16667 Ps	2.166667 R_x Lbs	2.166667 Z_BAR	2.166666667 M lb-ft
0.0	48	0.83	3.50	90.00	90.00	0.00	90.00	0.00	0	-2558	0
0.5	48	0.83	3.50	59.04	81.87	22.83	70.45	21.53	6	0.32	1
1	48	0.83	3.50	39.81	74.05	34.25	56.93	25.40	18	0.61	7
1.5	48	0.83	3.50	29.05	66.80	37.75	47.93	22.20	30	0.86	19
2	48	0.83	3.50	22.62	60.26	37.64	41.44	17.88	40	1.08	37
2.5	48	0.83	3.50	18.43	54.46	36.03	36.45	14.03	48	1.27	59
3	48	0.83	3.50	15.52	49.40	33.87	32.46	10.93	55	1.44	85
3.5	48	0.83	3.50	13.39	45.00	31.61	29.20	8.52	59	1.58	114
4	48	0.83	3.50	11.77	41.19	29.42	26.48	6.69	63	1.71	145
4.5	48	0.83	3.50	10.49	37.87	27.38	24.18	5.30	66	1.83	177
5	48	0.83	3.50	9.46	34.99	25.53	22.23	4.25	69	1.93	211
5.5	48	0.83	3.50	8.62	32.47	23.86	20.54	3.43	70	2.02	245
6	48	0.83	3.50	7.91	30.26	22.35	19.08	2.80	72	2.10	281
6.5	48	0.83	3.50	7.31	28.30	20.99	17.80	2.31	73	2.17	317
7	48	0.83	3.50	6.79	26.57	19.78	16.68	1.92	74	2.24	354
7.5	48	0.83	3.50	6.34	25.02	18.68	15.68	1.62	75	2.29	392
8	48	0.83	3.50	5.95	23.63	17.68	14.79	1.37	76	2.35	430
8.5	48	0.83	3.50	5.60	22.38	16.78	13.99	1.17	77	2.40	468
9	48	0.83	3.50	5.29	21.25	15.96	13.27	1.00	77	2.44	506
9.5	48	0.83	3.50	5.01	20.22	15.21	12.62	0.87	78	2.48	545
10	48	0.83	3.50	4.76	19.29	14.53	12.03	0.75	78	2.52	584
10.5	48	0.83	3.50	4.54	18.43	13.90	11.49	0.66	78	2.55	623
11	48	0.83	3.50	4.33	17.65	13.32	10.99	0.58	79	2.59	662
11.5	48	0.83	3.50	4.14	16.93	12.78	10.54	0.51	79	2.62	702
12	48	0.83	3.50	3.97	16.26	12.29	10.12	0.45	79	2.64	741
12.5	48	0.83	3.50	3.81	15.64	11.83	9.73	0.41	79	2.67	781
13	48	0.83	3.50	3.67	15.07	11.40	9.37	0.36	80	2.69	820
13.5	48	0.83	3.50	3.53	14.53	11.00	9.03	0.33	80	2.72	860
14	48	0.83	3.50	3.41	14.04	10.63	8.72	0.29	80	2.74	900
14.5	48	0.83	3.50	3.29	13.57	10.28	8.43	0.27	80	2.76	940
15	48	0.83	3.50	3.18	13.13	9.95	8.16	0.24	80	2.78	980

Wheel load	81,430	lbs	
Pu	114,002	lbs	
Anticipated eccentricity	12	in	
Check wall slenderness			
K	1		
lu	118	in	
h	16	in	
r	4.8	in	
Kl_u/r	24.6	<	100
Calculate magnified moments in non-sway condition			
E	3,372,165	psi	
I	14,763	in4	
Pc	813,002,530	lbs	
Cm	1		
dns	1.0		
f'c	3.5	ksi	
fy	60	ksi	
BarsizeĀ	#8		
BarspacingĀ	10	in	
As	3.46	in2/ft	
b	43.75	in	
h	16	in	
cover	2.5	in	
d	13	in	
a	1.59	in	
φMn	189.8	kft/ftĀ	
φVc	57.2	k	
Mu	68.6	kft/ftĀ	<fMn=OĀĀKĀ
Vu	2.5	k	<fVn=OĀĀKĀ



Overall View - Exaggerated Deflected Shape
Stresses produced with Maximum Possible Lift of 152 tons
ASTM A516 - 70 material
Highest stresses in top of holes within gussets as expected. Stresses approach yielding stress of material without fracture.



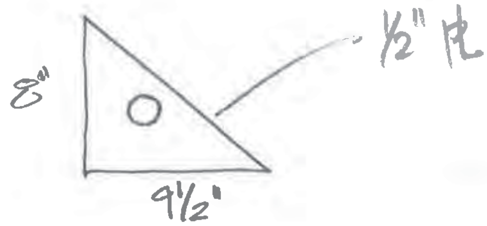
Close-up View - Exaggerated Deflected Shape
Local stresses in lifting points due to Maximum Possible Lift of 152 tons.
Localized stresses approach material yield of 42 ksi in areas adjacent to hole.

SIGMA ENGINEERING SOLUTIONS, INC.

COMP. BY: kd
CHK. BY:
DATE: 12/2/2016
SHEET NO.:
JOB NO.:

Subject: Exide Technology
Kettle Removal - weld strength

Determine strength of full penetration weld
Consider vertical leg only.



Full penetration weld governed by base material.

$R_n = F_{bm} \times A_{bm}$

$F_{bm} = 70\text{ksi}$

$A_{bm} = 1\cdot\frac{1}{2}" \times 8"$

$R_n = 70\text{ ksi} \times 1.5" \times 8"$
$= 840\text{k}$

Applied load $= 152T/4$
$= 76^k$

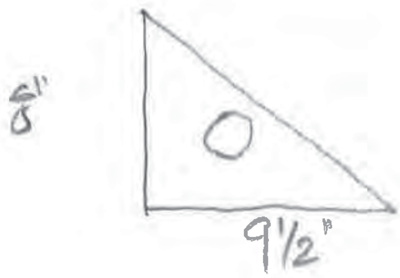
$R_n = 840^k \gg 76^k$

SIGMA ENGINEERING SOLUTIONS, INC.

COMP. BY: [illegible]
CHK. BY:
DATE: 12/5/2016
SHEET NO.:
JOB NO.:

Subject: Exide Technologies
Kettle Removal

Determine strength of double fillet welds
Consider vertical leg only



min. thickness for PL > 3/4"

$t_e = 0.707\,(5/16) = 0.25"$

$L = 8" \times 2 = 16"$

$R_n = 0.6\,F_{exx}\,L\,t_e = 0.6(70\text{ksi})16"(0.25") = 168^k$

$\frac{R_n}{\Omega} = \frac{168^k}{2.0} = 84^k > \frac{152^T \times 2}{4} = 76^k$

Σ SIGMA ENGINEERING SOLUTIONS, INC.

COMP. BY: kd
CHK. BY:
DATE: 12/6/2016
SHEET NO.:
JOB NO.:

Subject: Exide Technologies
Kettle extraction - Tunnel shoring

Evaluate tunnel lid capacity:

$f'_c = 3{,}000\text{psi}$ $f_y = 60{,}000\text{psi}$ $h = 12''$ cover $= 1\frac{1}{2}''$ A_s: #7@12"

$$a = \frac{A_s f_y}{0.85 f'_c b} = \frac{0.66 in^2 (60ksi)}{0.85(3ksi)(12'')} = 1.29''$$

$$\phi M_n = \phi A_s f_y (d - a/2) \qquad d = h - d - d_b/2 = 12'' - 1\frac{1}{2}'' - \frac{7}{8}/2 = 10.0625''$$

$$= \frac{0.9(.66)(60ksi)}{12''} \times \left(10.0625'' - \frac{1.29''}{2}\right) = 28.0 k\cdot ft$$

Determine demand from gantry leg

$P = 81.43^k$ $L = 9'$

$$M = \frac{81.43^k \cdot 9'}{4} = 183. k\text{-}ft > 28 k\cdot ft$$ = Supplemental shoring req'd.

Select post size

Max. height shored = 167'8" underside of tunnel lid
− 158'6" top of tunnel floor
9'2"

Approximate capacity of 9' #2 post = 15,400lbs. @3:1 F.S.

Use 8 - #2 posts

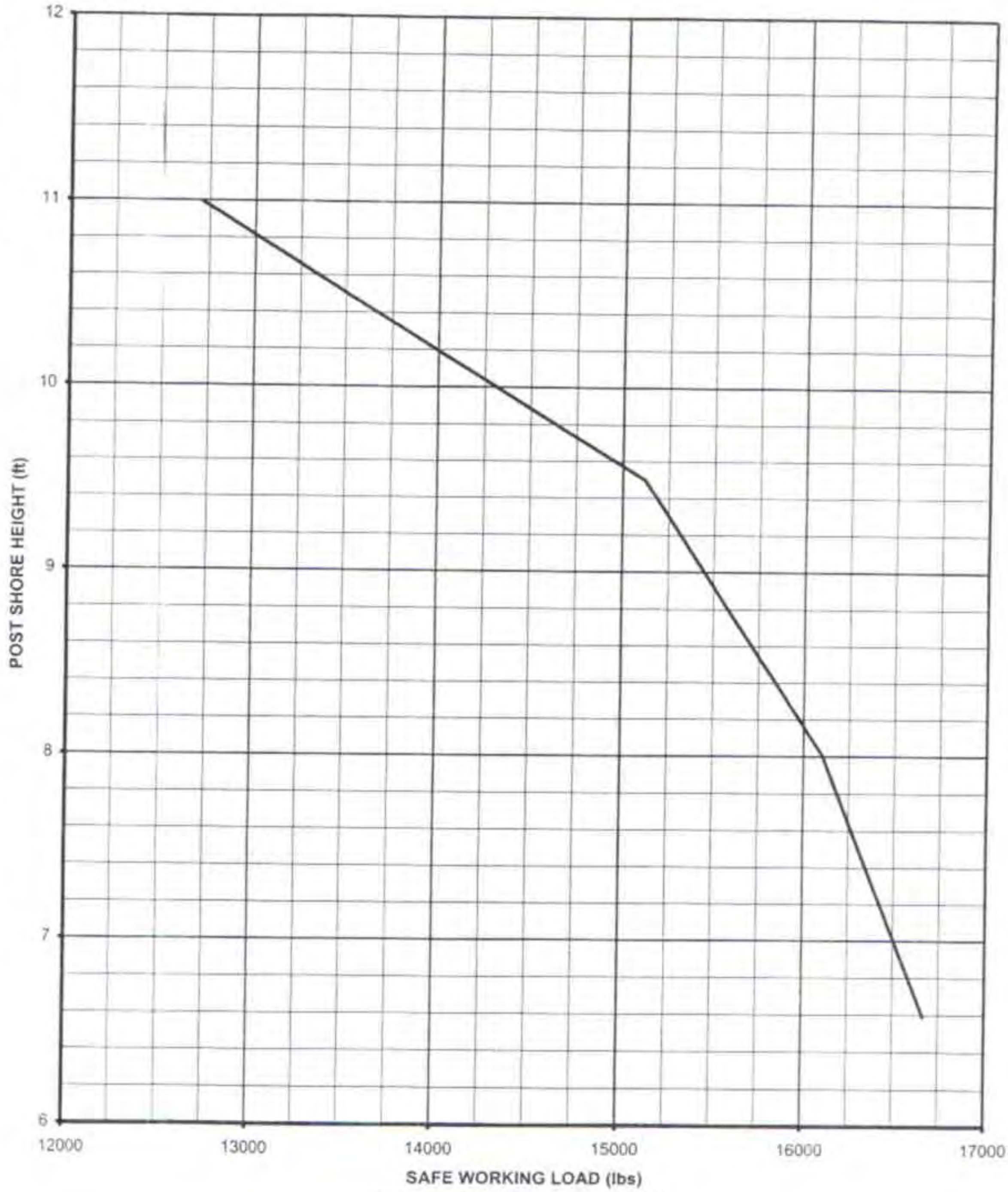
Distribute load w/ wide flange beam min. $t_w = 1/2''$.

Consider W10x79
W12x79
W14x82
} contractor's choice based on availability

SHORING

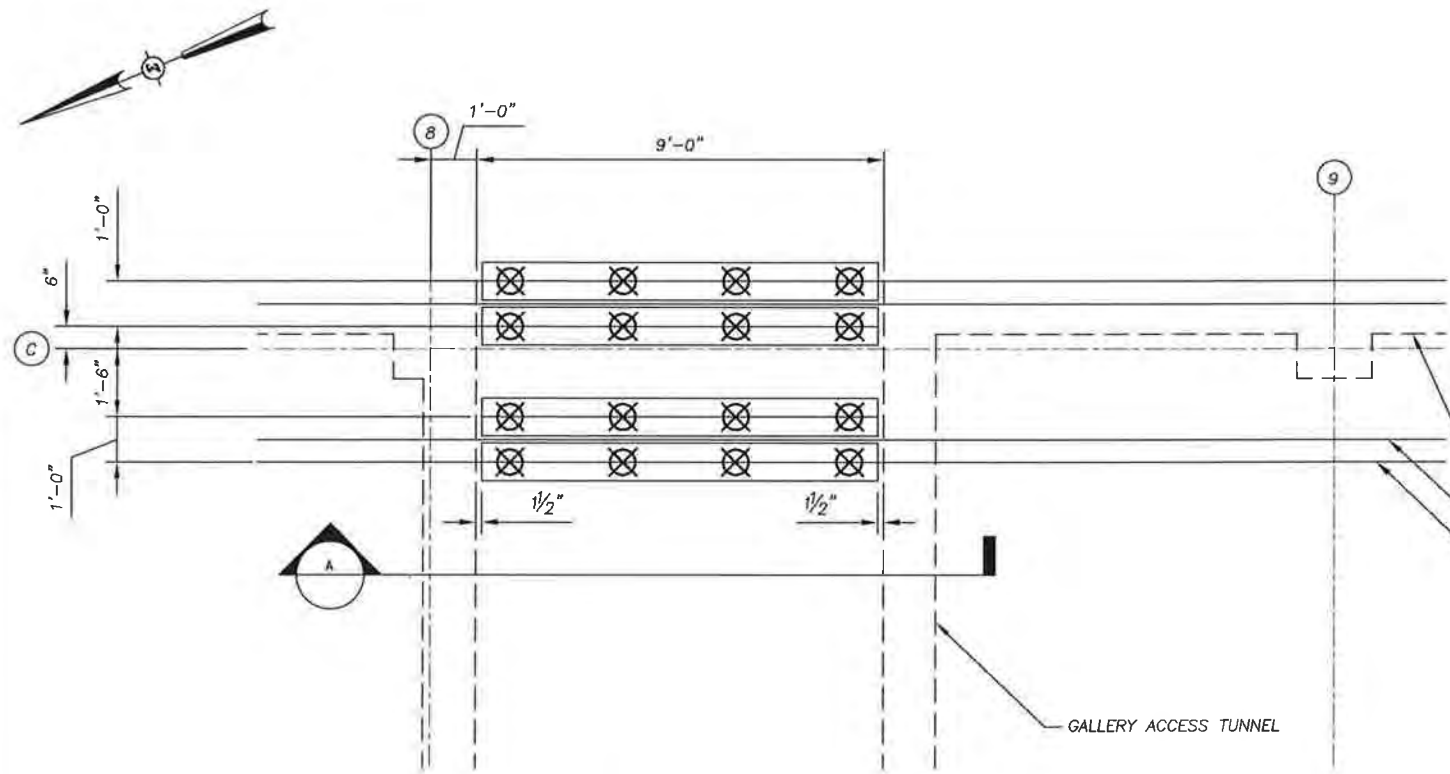
#2 TYPE HEAVY DUTY POST SHORE (RE-SHORING)

LOAD CHART FOR #2 HEAVY DUTY POST SHORE
(RE-SHORING CONDITION 3:1 SAFETY FACTOR)

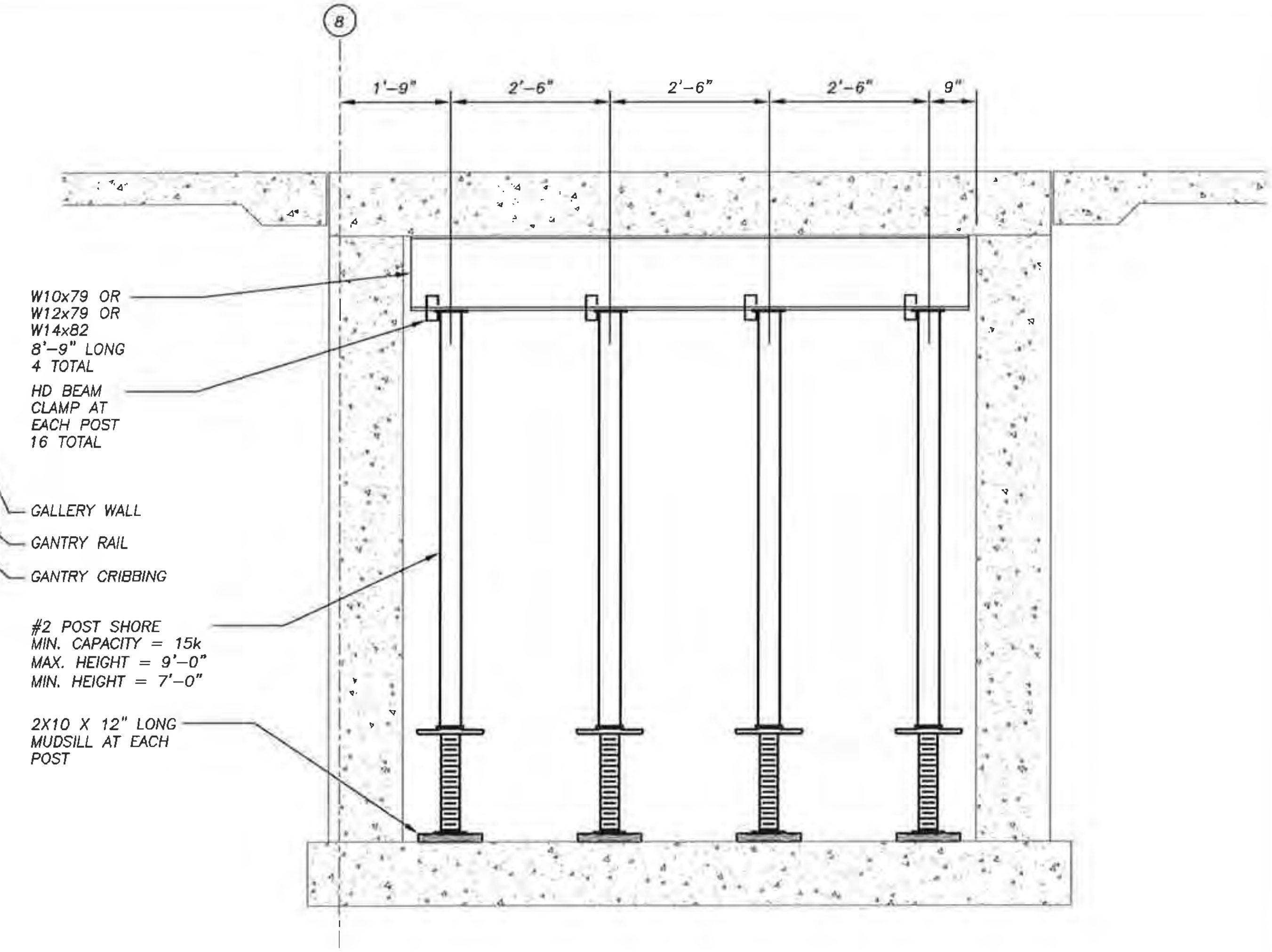


Factor of safety 3:1 Date of testing: July 2003

This information is subject to change -- It is Intended to be used by technically skilled designers, knowledgeable in the field, and is to be used with other data.



1 SHORING LAYOUT - PLAN
SCALE: 1/2 = 1'-0"



A SHORING LAYOUT - ELEVATION
SCALE: 3/4" = 1'-0"

GENERAL SHORING NOTES:

1. THESE PLANS ARE LIMITED TO LAYOUT OF SHORING REQUIRED ONLY.
2. MINIMUM SPECIFIED SHORING POST CAPACITY SHALL BE BASED ON A SAFE WORKING LOAD WITH A FACTOR OF SAFETY = 3.0.
3. MIN. SINGLE POST SHORE CAPACITY = 15 KIPS
4. CONTRACTOR SHALL CHECK AND SECURE ALL ELEMENTS OF THE SHORING SYSTEM EVERY WORK DAY BEFORE THE START OF CRANE OPERATING HOURS.

NO.	DATE	REVISIONS	BY	CK

NOTE:

CLIENT: American Integrated Services, Inc.
APPROVED | DATE

SIGMA ENGINEERING SOLUTIONS, INC.
6623 Schuster Street Las Vegas, NV 89118
WWW.SIGMANV.COM
PH. 702.247.4462 FAX 702.632.2838

DESIGNED KD | CHECKED JEF | DRAWN BC

REGISTERED PROFESSIONAL ENGINEER JOSEPH E. F... NO. C91983 EXP. 9-30-18 CIVIL STATE OF CALIFORNIA
12/7/16

EXIDE PLANT DECONSTRUCTION
VERNON, CALIFORNIA
SEGMENT 2
SUPPLEMENTARY VERTICAL ACCESS
GALLERY ACCESS TUNNEL

CONTRACT | DATE DECEMBER 6, 2016 | JOB 16_0350

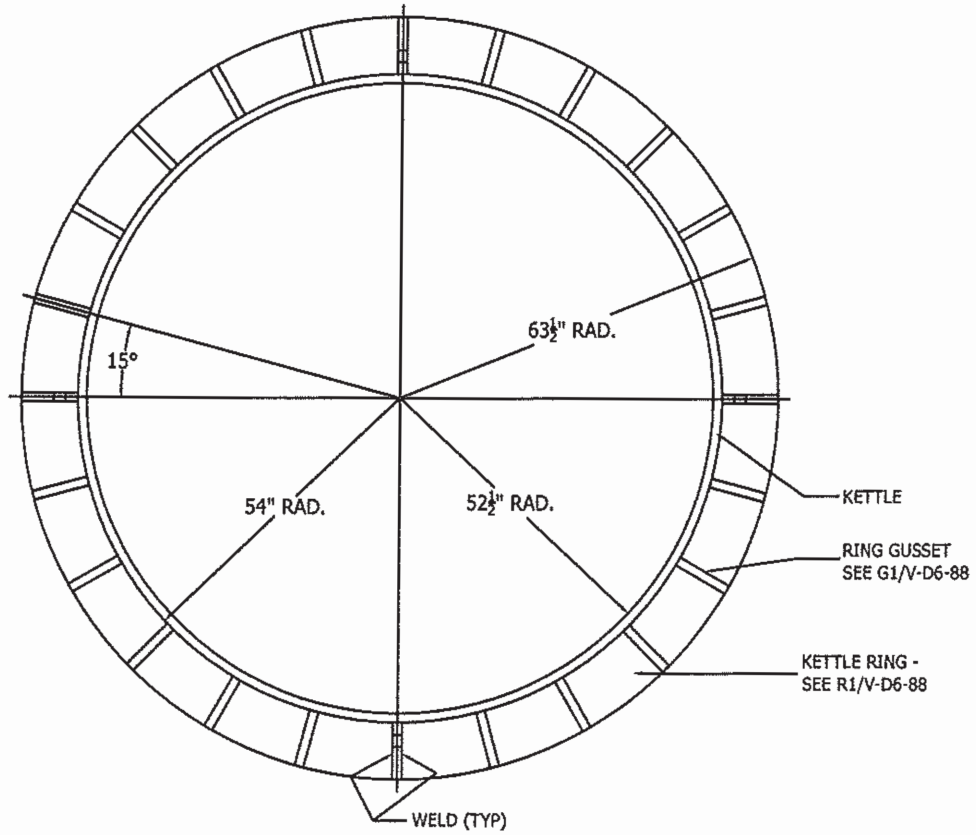
SHEET SD-74
DRAWING NO. 1 OF 1
REVISION 0
SCALE N.T.S.

APPENDIX B

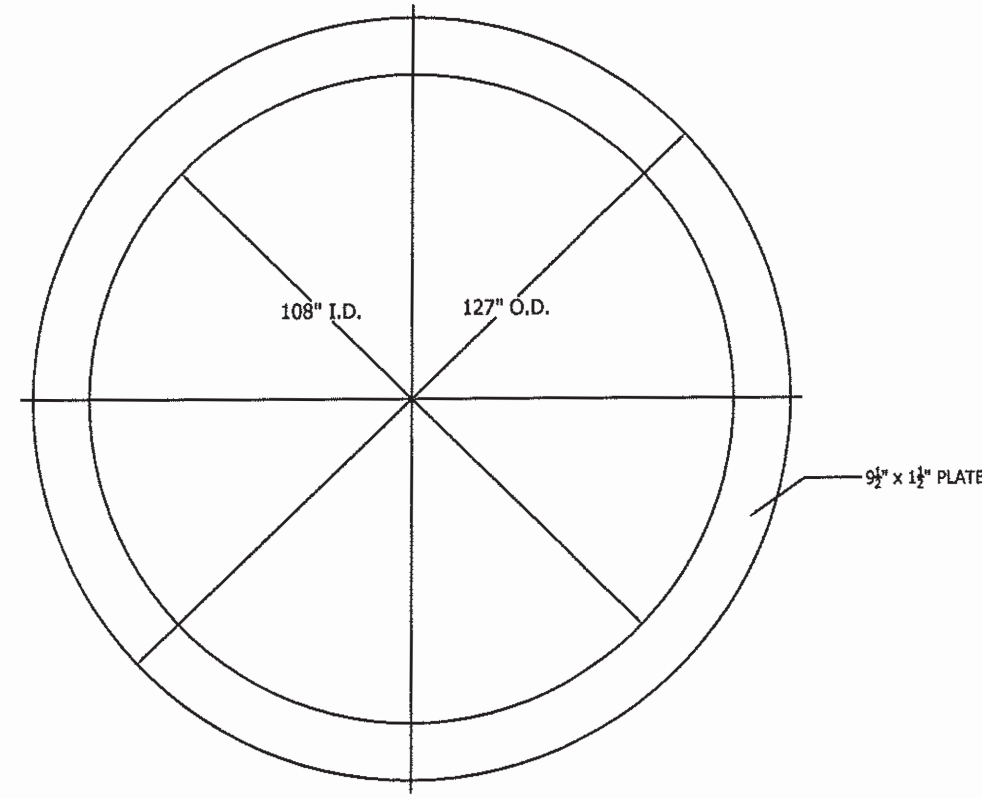
References:

1. As built drawings of kettle construction and materials (V-D6-88) by Exide Corporation dated 1/16/2009.
2. Ground bearing pressure due to applied loads from gantry system by Bigge Crane and Rigging Co dated November 30, 2016:
    a. *Kettle Lift General Arrangement*
    b. *Gantry Assembly*
    c. *Track Assembly*
    d. *Gantry System Analysis*
3. Comparative geotechnical properties from previous investigations:
    a. *Report – Soils investigation, West Coast Smelter Facility, Vernon, CA – Requisition No. 12253, Contract No. 7515* by Dames and Moore, May 5, 1980.
    b. *North Yard Soil Removal and Confirmation* by Philip Freeman dated September 30, 1980.
4. Preliminary geotechnical properties currently underway:
    a. *Figure 2 – Soil Data Gap Work Plan Proposed Soil Borings* by Advanced GeoServices dated 6/9/2016.
    b. *Preliminary Boring Logs TB-111I and TB-112S* dated 11/23/2016.
5. As-built drawings of Kettle Gallery (DC-201, -202, -207) by Exide Corporation dated 6/3/80.

REVISIONS		
REV. NO.	DATE	REVISION
1	9/30/2009	GUSSET TOTAL CHANGED FROM 28 TO 24

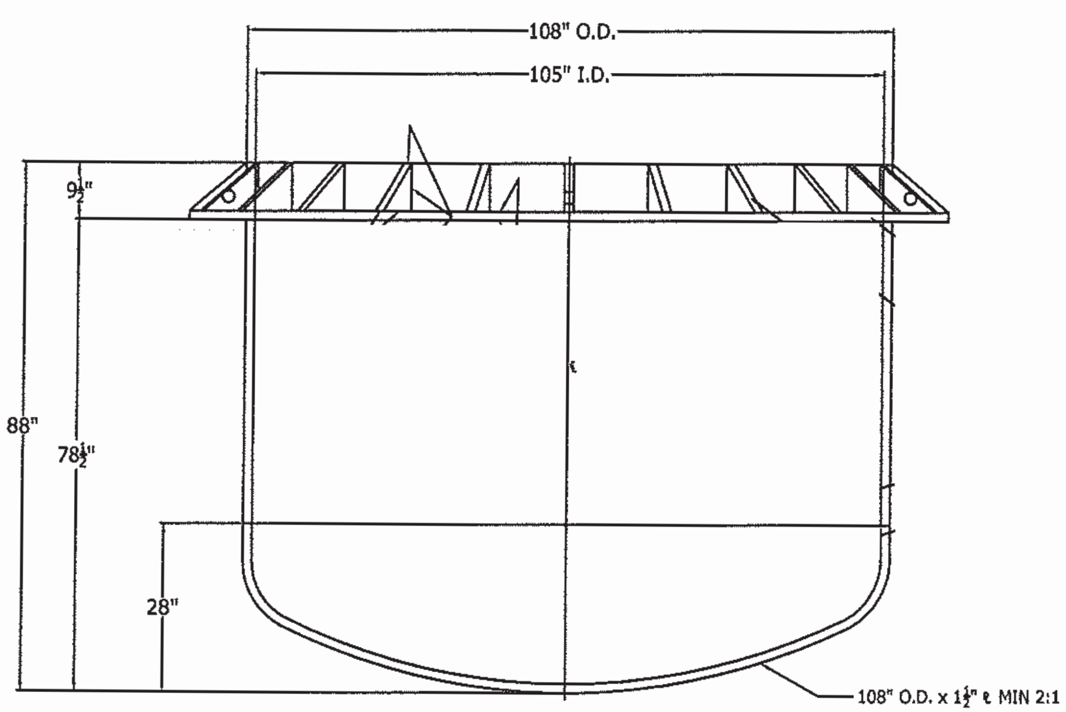


PLAN (V2 / V-D6-88)

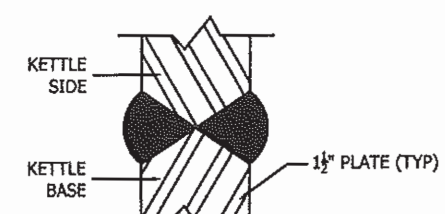


KETTLE RING (R1 / V-D6-88)

NOTES
(1) ALL STEEL IS TO BE ASTM A-516-70
(2) ALL SEAM WELDS TO BE 100% CHAMFERED WITH COMPLETE PENETRATION.
(3) ALL STEEL PLATE TO BE 1½" THICK
(4) ALL WELDS SHALL BE X-RAY TESTED.

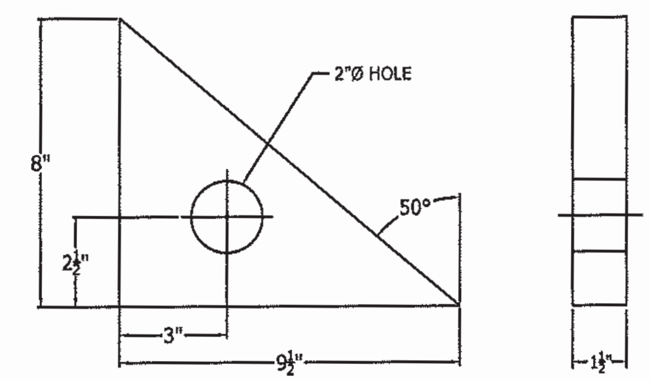


ELEVATION (V1 / V-D6-88)



TYPICAL KETTLE SEAM WELD (W1 / V-D6-88)

NOT TO SCALE



TYPICAL RING GUSSET (G1 / V-D6-88)

NOT TO SCALE

(20) PLATES REQUIRED WITHOUT HOLE
(4) PLATES REQUIRED WITH HOLE, 90° APART

EXIDE

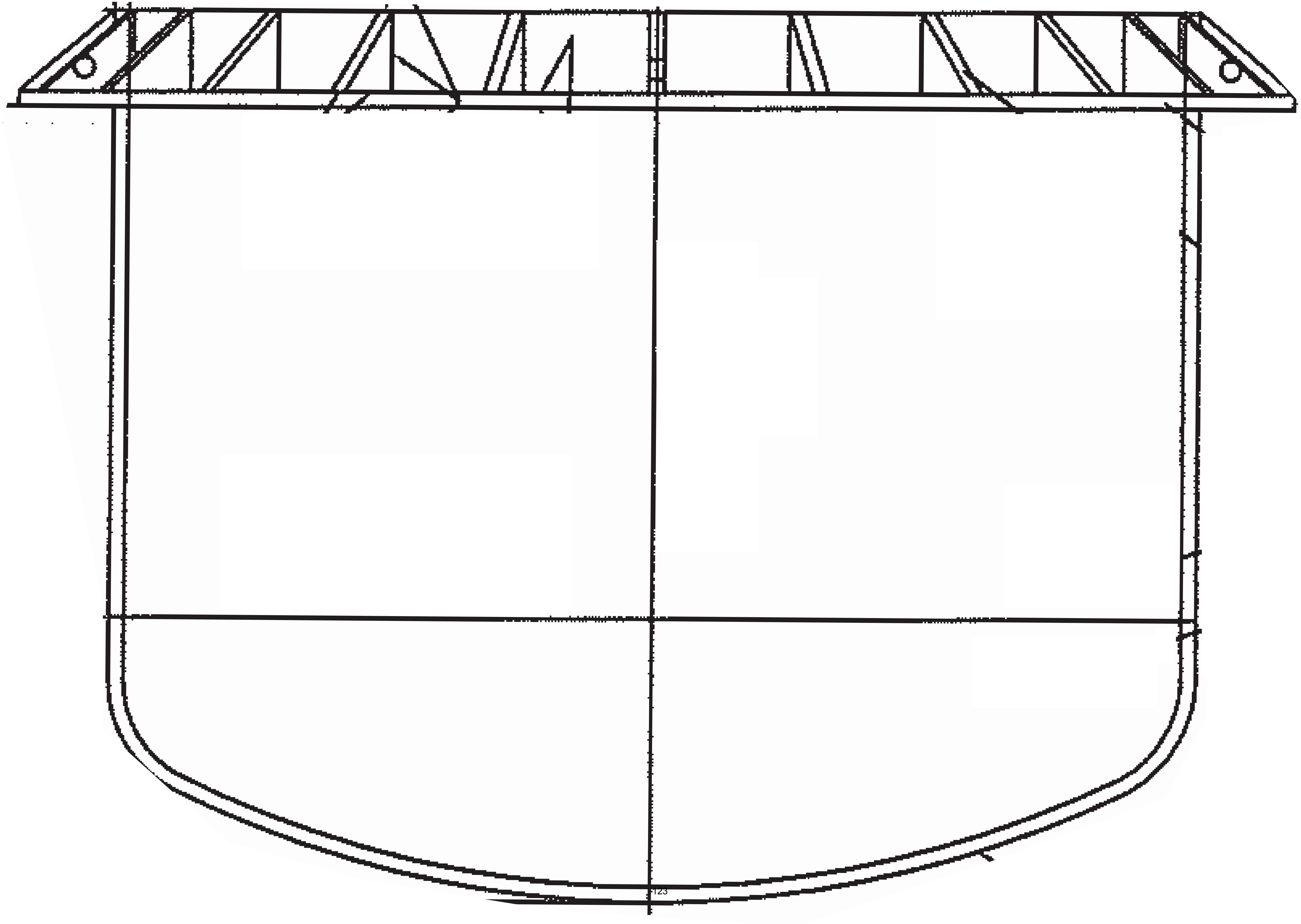
EXIDE CORPORATION VERNON, CA.

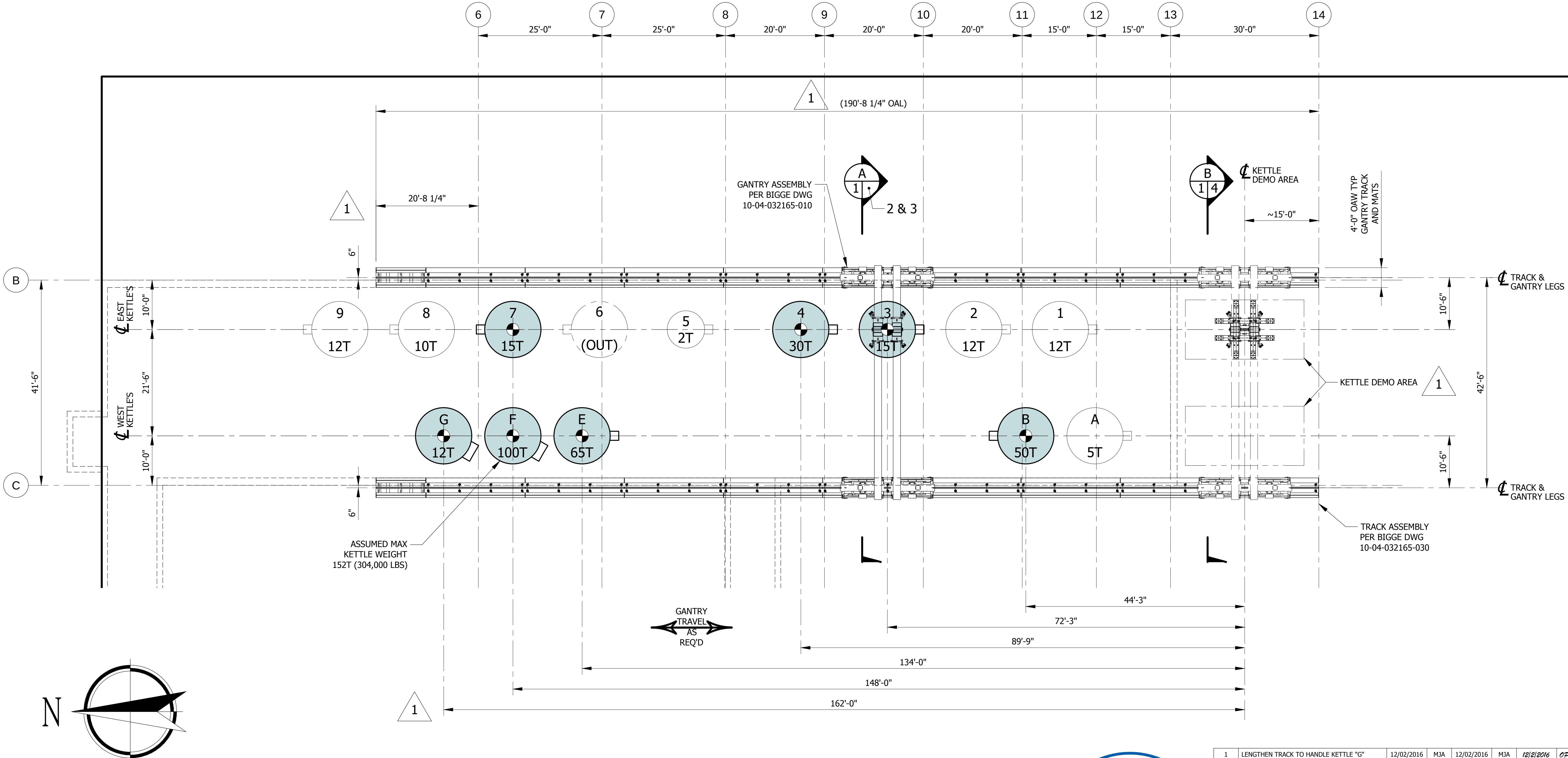
METALS DIVISION

VERNON - 100 TON KETTLE

DRAWN TLM	DATE 1/16/2009	SCALE ⅜" = 1' - 0"	
CHECKED	DRAWING NO. V-D6-88		REV. 1
APPROVED			

122 DO NOT SCALE - WORK TO DIMENSIONS
ALLOWABLE VARIATIONS ON DIMENSIONS ARE: TWO-PLACE DECIMALS ±0.010
THREE-PLACE DECIMALS ±0.005 FRACTIONS ±1/64





NOTES:

1. ONLY HIGHLIGHTED KETTLES WILL BE HANDLED WITH THE BIGGE GANTRY SYSTEM.

2. GANTRY SIDE SHIFT SHALL BE USED TO REPOSITION RIGGING FOR THE DIFFERENT EAST/WEST KETTLE LOCATIONS BUT NOT TO MOVE KETTLES WHILE SUSPENDED.

3. ESTIMATED MAXIMUM STATIC BEARING PRESSURE UNDER TRACK = 4.5 KSF.

PARTIAL PLAN VIEW
KETTLE LIFT GENERAL ARRANGEMENT

Date Signed: 12/06/2016
Digitally Signed by Damian Gronsky

NO.	REVISIONS	DRAWN DATE	DRAWN BY	CHECKED DATE	CHECKED BY	APPROVED DATE	APPROVED BY
1	LENGTHEN TRACK TO HANDLE KETTLE "G"	12/02/2016	MJA	12/02/2016	MJA	12/2/2016	OPH
0	ORIGINAL ISSUE	11/23/2016	MJA	11/23/2016	MJA	11/30/2016	OPH

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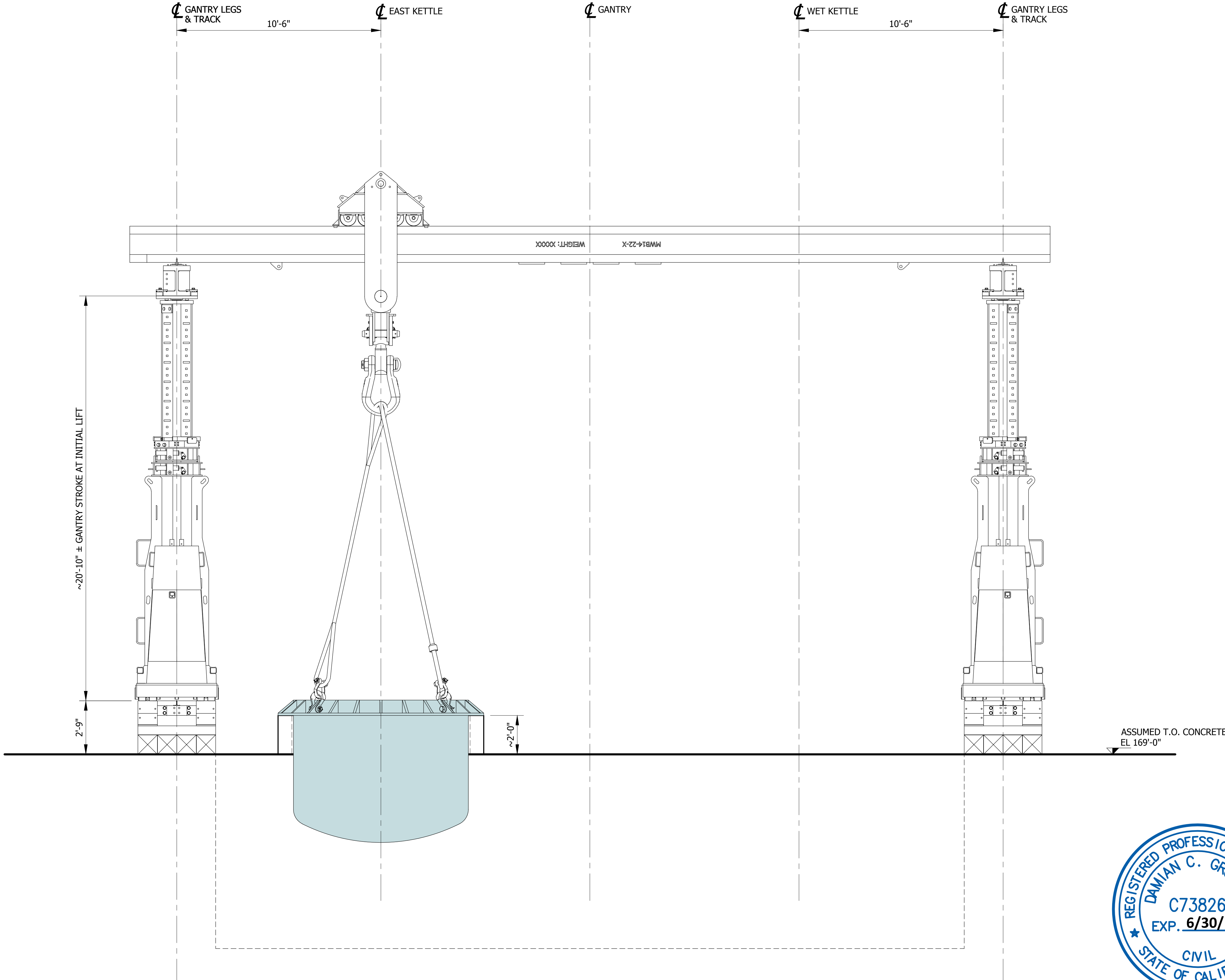
KETTLE LIFT GENERAL ARRANGEMENT
PARTIAL PLAN VIEW
EXIDE KETTLE REMOVAL
AMERICAN INTEGRATED SERVICES

SCALE: (U.N.O)	SIZE	PROJECT No.	DWG. No.	SHEET	REV.
1"=20'-0"	B	10-04-032165	001	1 of 4	1



A 1|2 END ELEVATION - INITIAL LIFT POSITION

(EAST KETTLE HANDLING SHOWN, WEST KETTLE SIMILAR)

REGISTERED PROFESSIONAL ENGINEER
DAMIAN C. GRONSKY
C73826
EXP. 6/30/17
CIVIL
STATE OF CALIFORNIA

Date Signed: **12/06/2016**
Digitally Signed by Damian Gronsky

NO.	REVISIONS	DATE	BY	DATE	BY	DATE	BY
0	ORIGINAL ISSUE	11/23/2016	MJA	11/23/2016	MJA	11/30/2016	OPH
		DRAWN		CHECKED		APPROVED	

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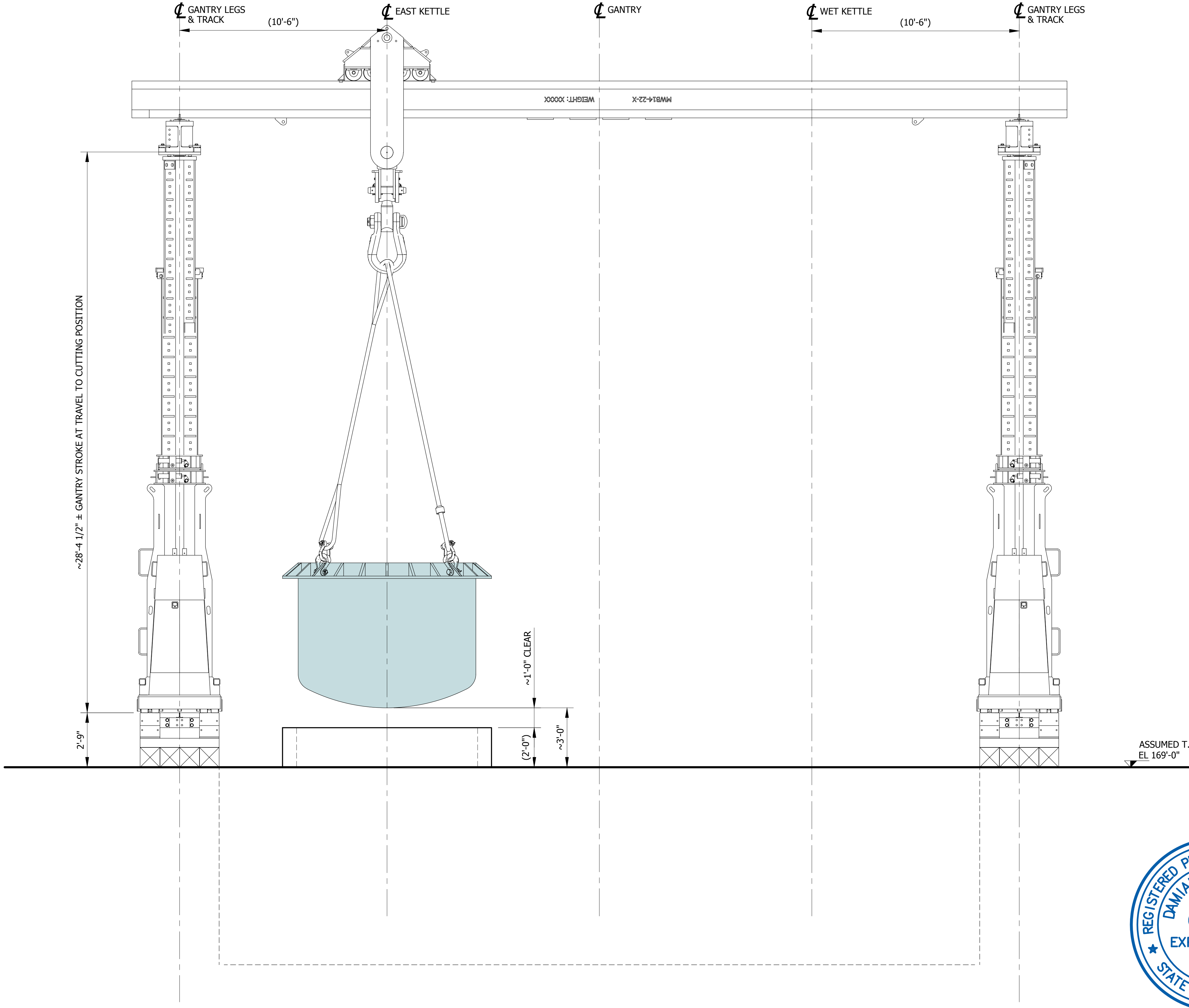
KETTLE LIFT GENERAL ARRANGEMENT
ELEVATION VIEW - INITIAL LIFT POSITION
EXIDE KETTLE REMOVAL
AMERICAN INTEGRATED SERVICES

SCALE: (U.N.O)	SIZE	PROJECT No.	DWG. No.	SHEET	REV.
3/16"=1'-0"	B	10-04-032165	001	2 of 4	1



GANTRY LIFT DATA		
TYPE:	J&R 1400 SERIES	
EXTENSION:	28'-4 1/2" (30'-7" MAX)	
STAGE AT EXTENSION:	2ND (WITHOUT MANUAL EXTENDED)	
RATED CAPACITY PER SINGLE GANTRY AT EXTENDED STAGE:	235,000	LBS
PRESSURE AT RATED CAPACITY:	3,000	PSI
MAX LOAD TO SINGLE GANTRY:	141,500	LBS
ESTIMATED MAX PRESSURE FOR MAX LOAD TO SINGLE GANTRY:	1,806	PSI
% CAPACITY FOR MAX LOAD TO SINGLE GANTRY:	60.2%	

*THIS DATA SHOWN IS FOR THE WORST CASE SINGLE GANTRY LOAD, WITHOUT IMPACT (WEST GANTRIES FOR 152T LIFT)

A
1|3

END ELEVATION - TRAVEL POSITION

(EAST KETTLE HANDLING SHOWN, WEST KETTLE SIMILAR)

Date Signed: 12/06/2016
Digitally Signed by Damian Gronsky

NO.	REVISIONS	DATE	BY	DATE	BY	DATE	BY
0	ORIGINAL ISSUE	11/23/2016	MJA	11/23/2016	MJA	11/30/2016	OPH
		DRAWN		CHECKED		APPROVED	

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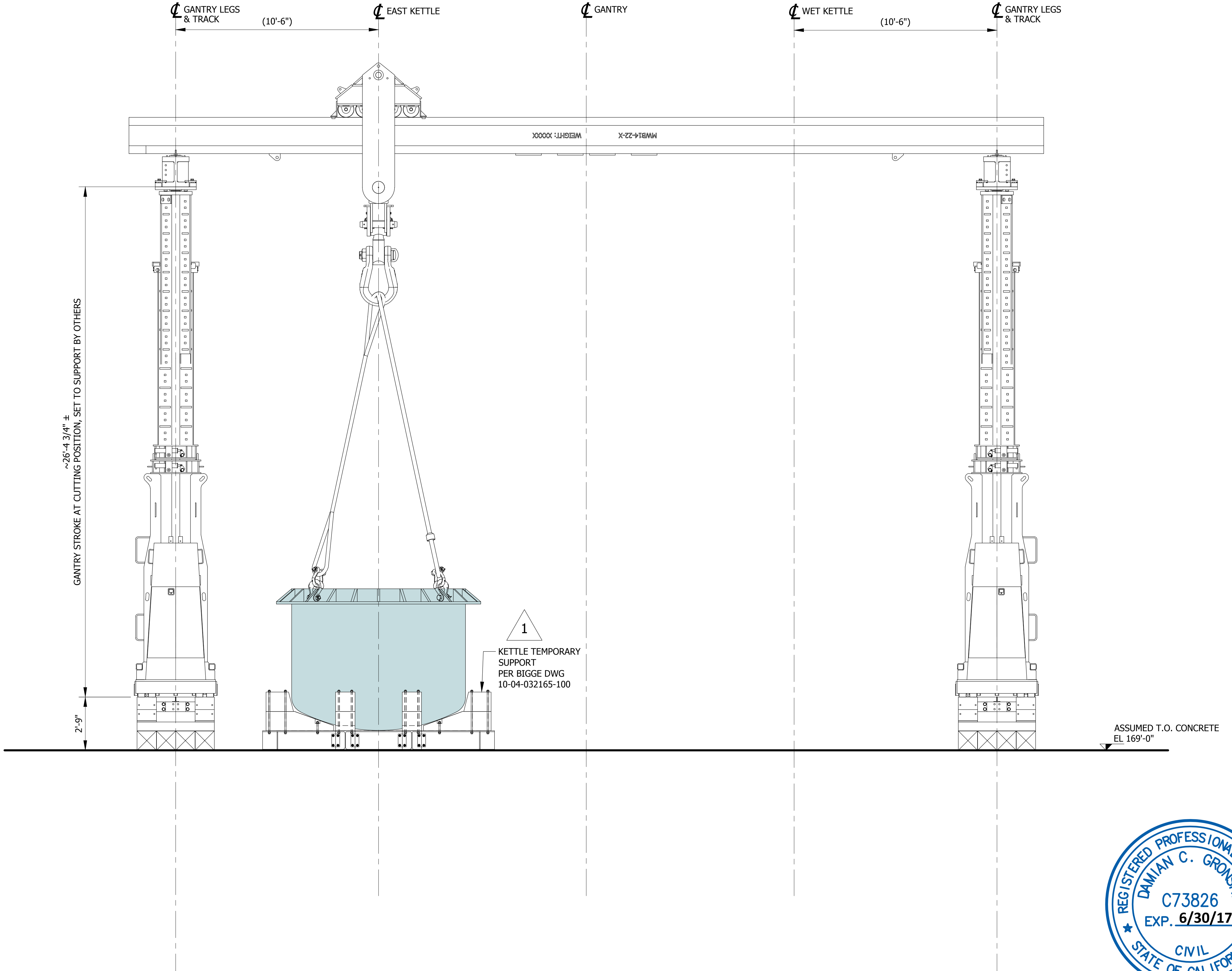
KETTLE LIFT GENERAL ARRANGEMENT
ELEVATION VIEW - TRAVEL POSITION
EXIDE KETTLE REMOVAL
AMERICAN INTEGRATED SERVICES

SCALE: (U.N.O)	SIZE	PROJECT No.	DWG. No.	SHEET	REV.
3/16"=1'-0"	B	10-04-032165	001	3 of 4	1



B
1 | 4

END ELEVATION - KETTLE DEMO AREA

(EAST KETTLE HANDLING SHOWN, WEST KETTLE SIMILAR)

REGISTERED PROFESSIONAL ENGINEER
DAMIAN C. GRONSKY
C73826
EXP. 6/30/17
CIVIL
STATE OF CALIFORNIA

Damian Gronsky
Date Signed: **12/06/2016**
Digitally Signed by Damian Gronsky

NO.	REVISIONS	DRAWN DATE	DRAWN BY	CHECKED DATE	CHECKED BY	APPROVED DATE	APPROVED BY
1	REF. BIGGE PROVIDED KETTLE SUPPORTS	12/02/2016	MJA	12/02/2016	MJA	12/2/2016	OPH
0	ORIGINAL ISSUE	11/23/2016	MJA	11/23/2016	MJA	11/30/2016	OPH

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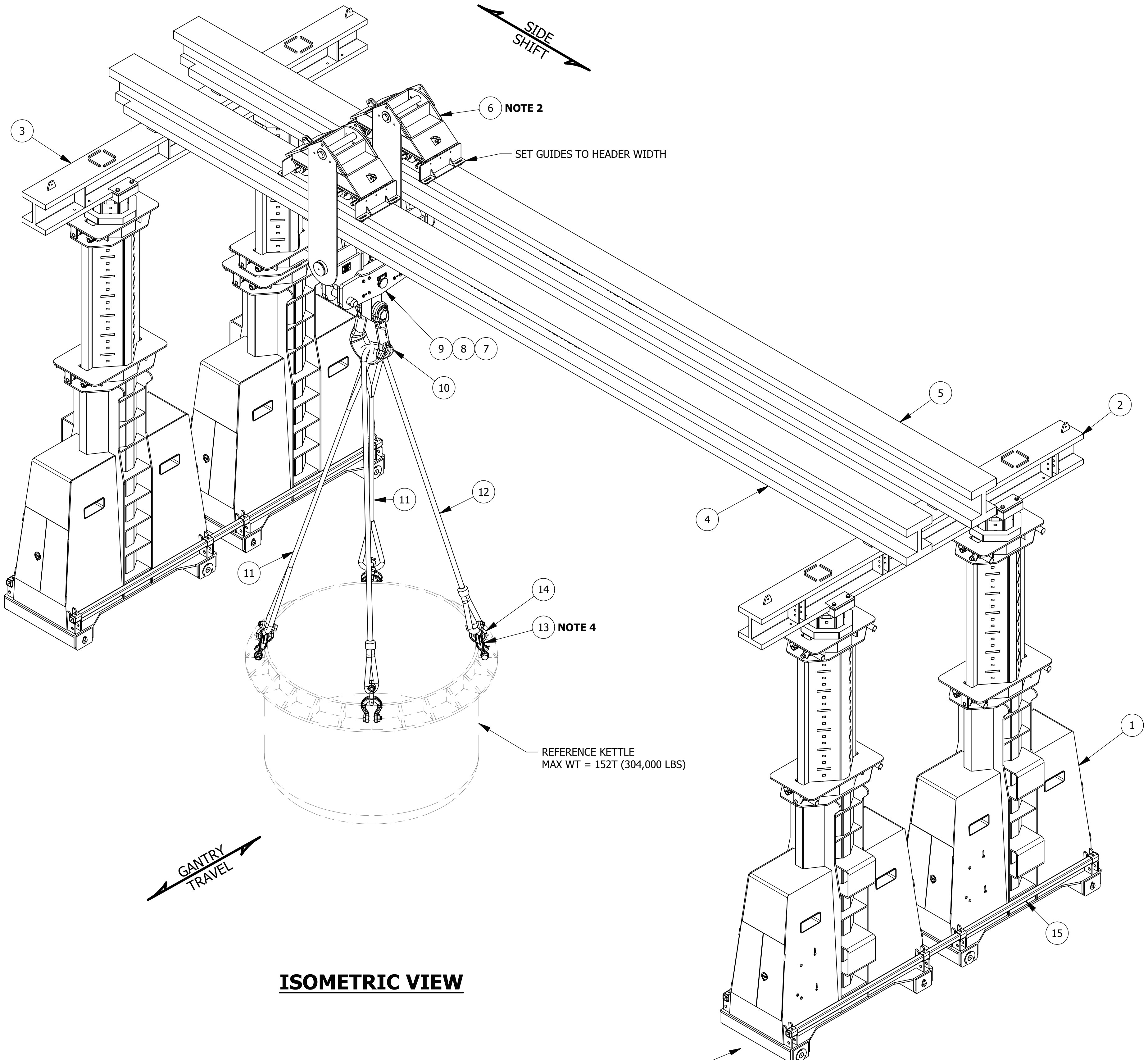
KETTLE LIFT GENERAL ARRANGEMENT
ELEVATION VIEW - KETTLE DEMO AREA
EXIDE KETTLE REMOVAL
AMERICAN INTEGRATED SERVICES

SCALE: (U.N.O)	SIZE	PROJECT No.	DWG. No.	SHEET	REV.
3/16"=1'-0"	B	10-04-032165	001	4 of 4	1



ISOMETRIC VIEW

PARTS LIST

ITEM	QTY	PART No.	DESCRIPTION	WEIGHT EA (LBS)	WEIGHT TOTAL (LBS)
1	4	HG700	J&R 1400 SERIES HYDRAULIC GANTRY (700T CAP)	22300	89200
2	1	MWB14-15	MODIFIED W14x426 x 19'-1" (A992)	8471	8471
3	1	MWB14-14	MODIFIED W14x426 x 19'-1" (A992)	8471	8471
4	1	MWB14-22	MODIFIED W14x730 x 47'-4" (A992)	34545	34545
5	1	MWB14-23	MODIFIED W14x730 x 47'-4" (A992)	34547	34547
6	2		SIDE SHIFT - DRIVE - LIFT SYSTEMS 100T CAPACITY	2441	4882
7	2	RL90-17	90° LINK	411	822
8	2	RP4-4	Ø3.975" X 1'-11" RIGGING PIN	78	157
9	1	SB-187	250T SWIVEL SPREADER	1907	1907
10	1		300T CROSBY G-2160 WIDE BODY SHACKLE, OR EQ.	777	777
11	2		IWRC EIPS Ø2 1/4" X 15'-0", VERTICAL STRAIGHT SWL=44T, OR EQ.	220	440
12	1		IWRC EIPS Ø2 1/2" X 30'-0", VERTICAL BASKET SWL=109T, OR EQ.	500	500
13	4		40T CROSBY G-2160 WIDE BODY SHACKLE, OR EQ.	46	184
14	4		40T CROSBY G-2140 ALLOY BOLT TYPE SHACKLE, OR EQ.	34	135
15	4		HG700 TIE STRUT, ~18'-4" LONG, FOR 10'-0" GAUGE	162	647

TOTAL WT (LBS) = 185,685

NOTES:

1. ALL PINS SHALL HAVE SUITABLE KEEPERS.
2. REPLACE THE SIDE SHIFT SYSTEM LOAD HOLDER ATTACHMENT (BOTTOM LINK) WITH RL90-17 SO IT CAN CONNECT WITH SB187 (ITEM #9).
3. COMMON HEADER BEAM LOCATIONS ARE INTERCHANGEABLE, I.E. ITEMS #2 & 3, OR #4 & 5, CAN BE SWAPPED.
4. KETTLE RIGGING POINTS TO BE MODIFIED BY OTHERS AS NECESSARY TO FACILITATE THE INDICATED SHACKLE CONNECTION AND SAFE HANDLING OF THE KETTLES.

REGISTERED PROFESSIONAL ENGINEER
DAMIAN C. GRONSKY
C73826
EXP. 6/30/17
CIVIL
STATE OF CALIFORNIA

Date Signed: **12/06/2016**
Digitally Signed by Damian Gronsky

NO.	REVISIONS	DATE	BY	DATE	BY	DATE	BY
0	ORIGINAL ISSUE	11/23/2016	MJA	11/23/2016	MJA	11/30/2016	OPH
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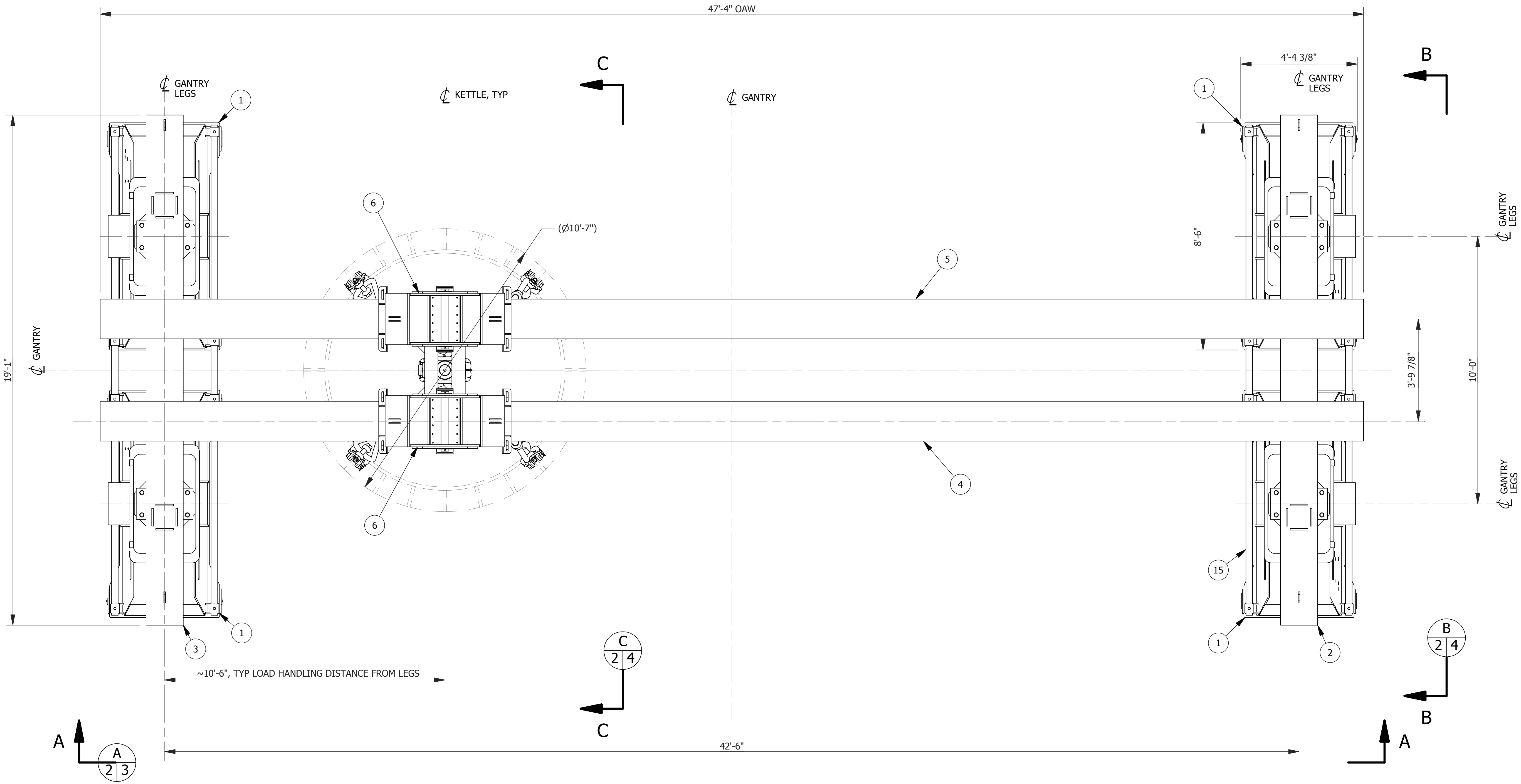
EXIDE KETTLE REMOVAL
AMERICAN INTEGRATED SERVICES

SCALE: (U.N.O)	SIZE	PROJECT No.	DWG. No.	SHEET	REV.
NTS	B	10-04-032165	010	1 of 4	0



PLAN VIEW

REGISTERED PROFESSIONAL ENGINEER
DAMIAN C. GRONSKY
C73826
EXP. 6/30/17
CIVIL
STATE OF CALIFORNIA

Date Signed: 12/06/2016
Digitally Signed by Damian Gronsky

NO.	REVISIONS	DATE	BY	DATE	BY	DATE	BY
0	ORIGINAL ISSUE	11/23/2016	MJA	11/23/2016	MJA	11/30/2016	OPH
		DRAWN		CHECKED		APPROVED	

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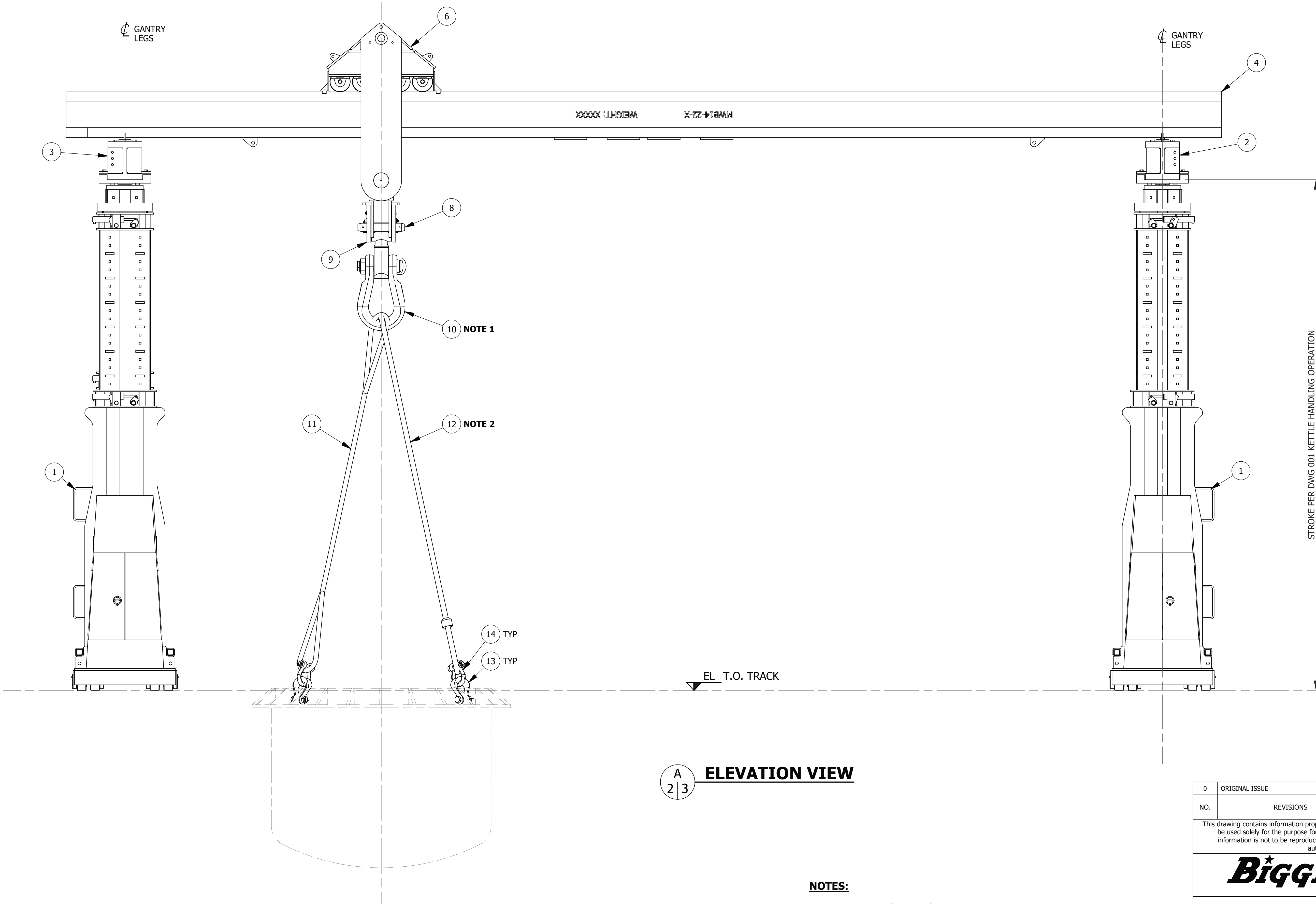
GANTRY ASSEMBLY
PLAN VIEW
EXIDE KETTLE REMOVAL
AMERICAN INTEGRATED SERVICES

SCALE: (U.N.O)	SIZE	PROJECT No.	DWG. No.	SHEET	REV.
1/4" = 1'-0"	B	10-04-032165	010	2 of 4	0



A 2|3 ELEVATION VIEW

REGISTERED PROFESSIONAL ENGINEER
DAMIAN C. GRONSKY
C73826
EXP. 6/30/17
CIVIL
STATE OF CALIFORNIA

Damian Gronsky
Date Signed: 12/06/2016
Digitally Signed by Damian Gronsky

NOTES:

1. ENSURE SHACKLE (ITEM #10) IS ORIENTED SO SLINGS ARE NOT TWISTED OR BOUND PRIOR TO LIFTING A KETTLE.
2. ITEM #12 (BASKET SLING) SHALL BE CONNECTED TO ADJACENT RIGGING POINTS ONLY (NOT OPPOSITE), TO PROVIDE A STABLE 3-POINT LIFT SYSTEM.

NO.	REVISIONS	DATE	BY	DATE	BY	DATE	BY
0	ORIGINAL ISSUE	11/23/2016	MJA	11/23/2016	MJA	11/30/2016	OPH
		DRAWN		CHECKED		APPROVED	

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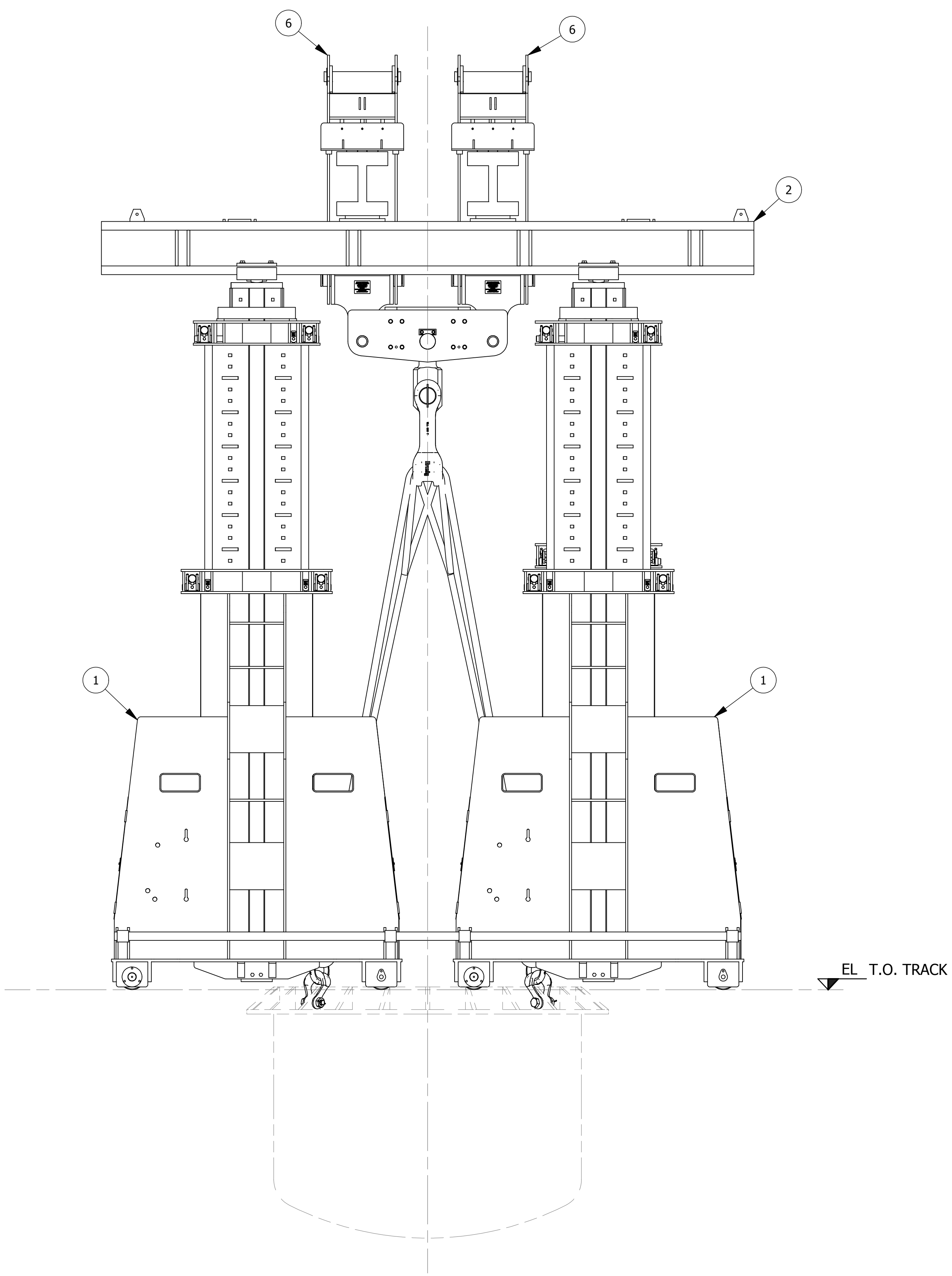
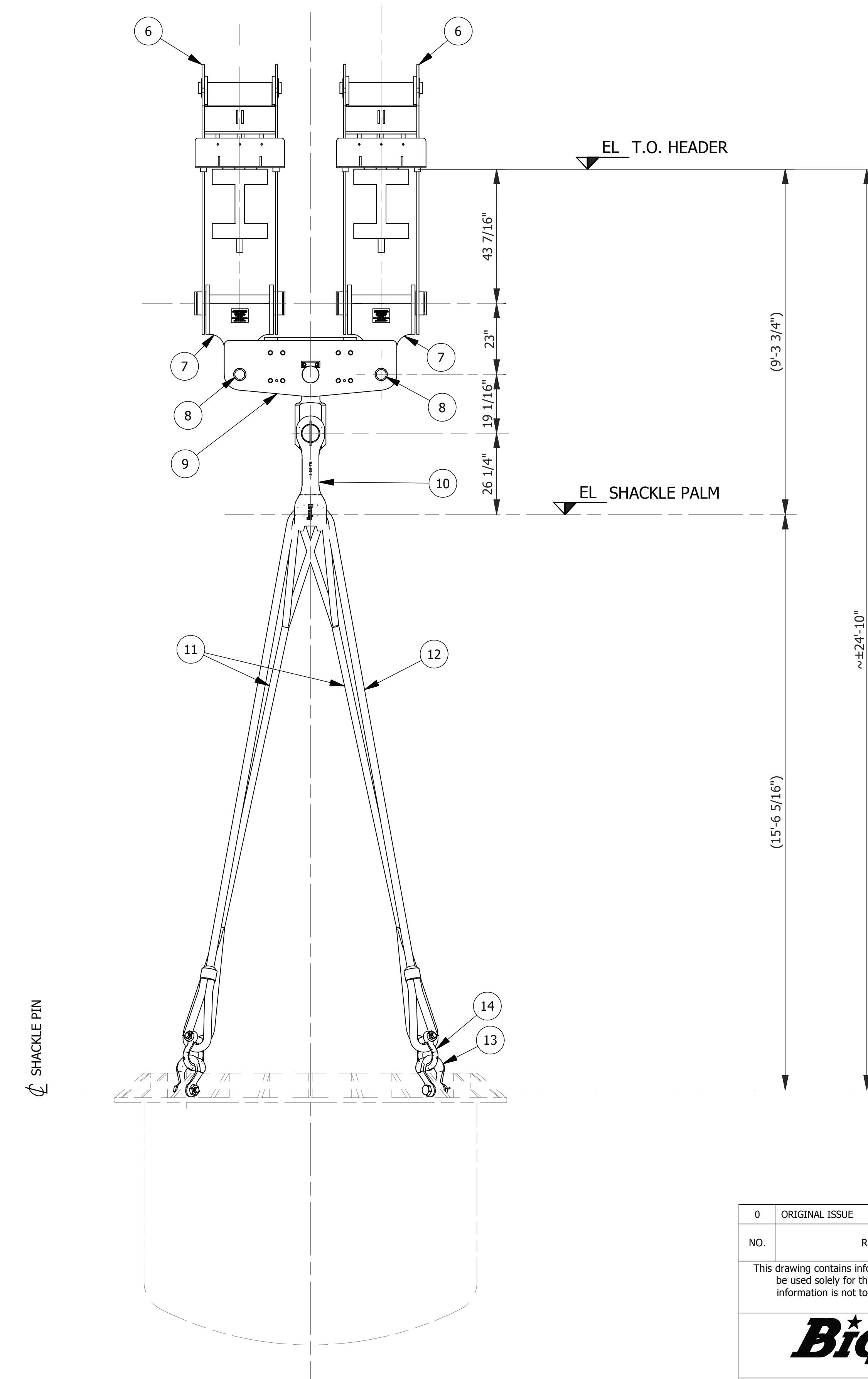
GANTRY ASSEMBLY
ELEVATION VIEW
EXIDE KETTLE REMOVAL
AMERICAN INTEGRATED SERVICES

SCALE: (U.N.O)	SIZE	PROJECT No.	DWG. No.	SHEET	REV.
1/4" = 1'-0"	B	10-04-032165	010	3 of 4	0



B 2 4 **END ELEVATION**



C 2 4 **END ELEVATION**

TYP KETTLE RIGGING

REGISTERED PROFESSIONAL ENGINEER
DAMIAN C. GRONSKY
C73826
EXP. 6/30/17
CIVIL
STATE OF CALIFORNIA

Date Signed: 12/06/2016
Digitally Signed by Damian Gronsky

NO.	REVISIONS	DRAWN DATE	DRAWN BY	CHECKED DATE	CHECKED BY	APPROVED DATE	APPROVED BY
0	ORIGINAL ISSUE	11/23/2016	MJA	11/23/2016	MJA	11/30/2016	OPH

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GANTRY ASSEMBLY
END ELEVATIONS
EXIDE KETTLE REMOVAL
AMERICAN INTEGRATED SERVICES

SCALE: (U.N.O)	SIZE	PROJECT No.	DWG. No.	SHEET	REV.
1/4"=1'-0"	B	10-04-032165	010	4 of 4	0

NOTES:

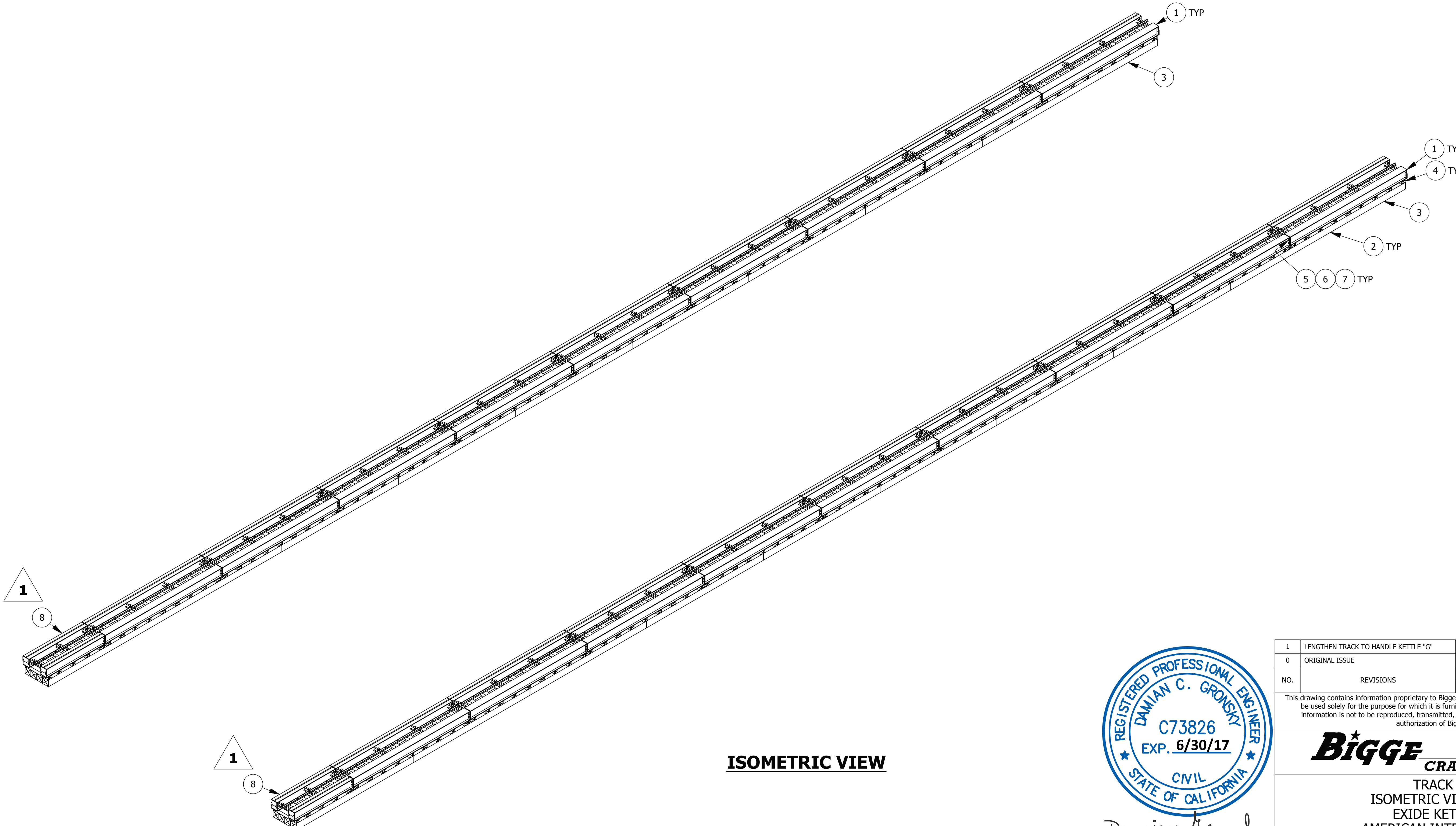
1. ALTERNATE GANTRY TRACK AND TIMBER MAT LENGTHS MAY BE USED AS NECESSARY TO ADDRESS FIELD CONDITIONS.
2. INDICATED FLOOR ELEVATIONS ARE BASED ON ORIGINAL BUILDING PLANS AND DO NOT INDICATE SLOPE OR OTHER FEATURES THAT WILL LIKELY NEED TO BE ADDRESSED. A SURVEY OF THE EXISTING FLOOR CONDITIONS SHOULD BE OBTAINED PRIOR TO RUNWAY INSTALLATION TO CONFIRM ACTUAL ELEVATIONS AND CRIBBING REQUIREMENTS.

1

PARTS LIST

ITEM	QTY	PART No.	DESCRIPTION	WEIGHT EA (LBS)	WEIGHT TOTAL (LBS)
1	18	HGR-3	HYDRAULIC GANTRY TRACK, 20'-0"	5153	92761
2	18		4' x 20' x 12" TIMBER MAT	3200	57600
3	2		4' x 10' x 12" TIMBER MAT	1600	3200
4	190		TIMBER, 6" x 8" x 48"	46	8708
5	144		HEX HEAD CAP SCREW, 3/4"-10 UNC x 3.5", SAE J429 GRADE 5, ZINC COATED	1	84
6	288		WASHER, 3/4", SAE THRU HARDENED, ZINC COATED	0	13
7	144		HEX NUT, 3/4"-10 UNC, SAE J995 GRADE 5, ZINC COATED	0	20
8	2	HGR-1	HYDRAULIC GANTRY TRACK, 10'-0"	2741	5482

TOTAL WT (LBS) = 167,868



ISOMETRIC VIEW

REGISTERED PROFESSIONAL ENGINEER
DAMIAN C. GRONSKY
C73826
EXP. 6/30/17
CIVIL
STATE OF CALIFORNIA

Damian Gronsky
Date Signed: **12/06/2016**
Digitally Signed by Damian Gronsky

NO.	REVISIONS	DATE	BY	DATE	BY	DATE	BY
1	LENGTHEN TRACK TO HANDLE KETTLE "G"	12/2/2016	MJA	12/2/2016	MJA	12/2/2016	OPH
0	ORIGINAL ISSUE	11/28/2016	MJA	11/28/2016	MJA	11/30/2016	OPH
		DRAWN		CHECKED		APPROVED	

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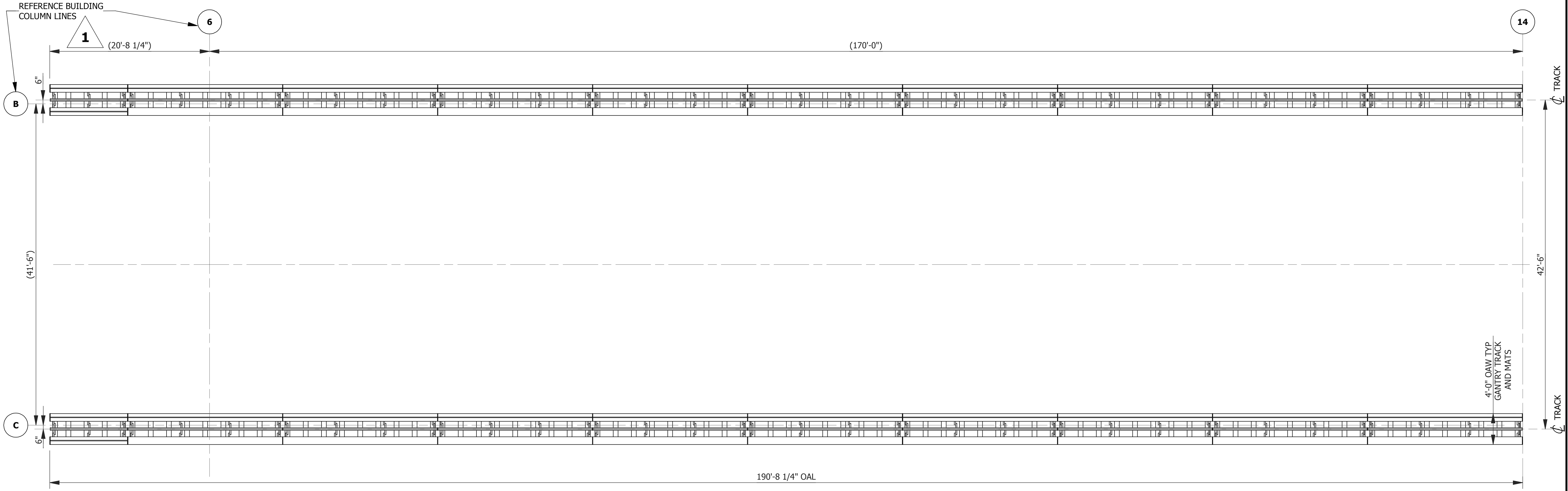
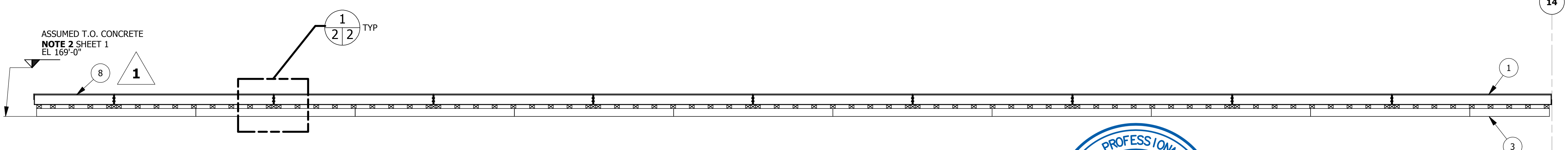
TRACK ASSEMBLY
ISOMETRIC VIEW & PARTS LIST
EXIDE KETTLE REMOVAL
AMERICAN INTEGRATED SERVICES

SCALE: (U.N.O)	SIZE	PROJECT No.	DWG. No.	SHEET	REV.
NTS	B	10-04-032165	030	1 of 2	1



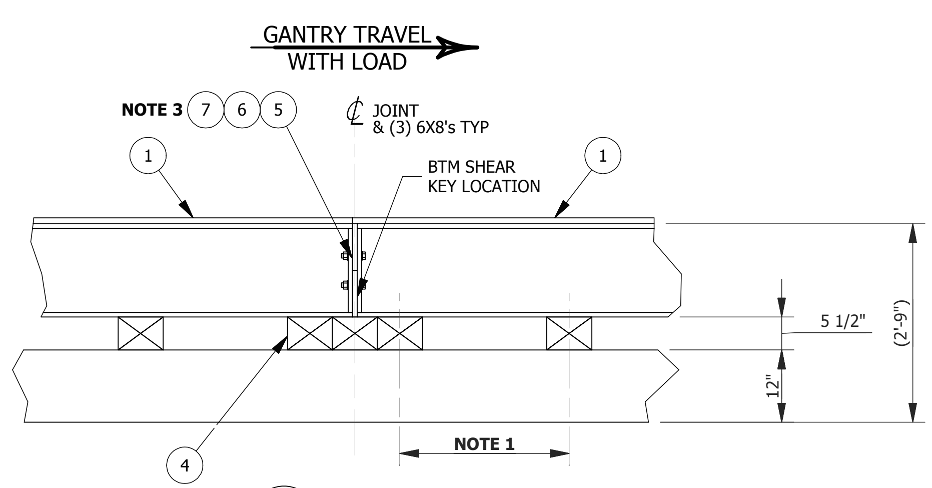
PLAN VIEW



ELEVATION VIEW

REGISTERED PROFESSIONAL ENGINEER
DAMIAN C. GRONSKY
C73826
EXP. 6/30/17
CIVIL
STATE OF CALIFORNIA

Damian Gronsky
Date Signed: 12/06/2016
Digitally Signed by Damian Gronsky



1/2 2 DETAIL

SCALE: 3/8" = 1'-0"

NOTES:

1

1. 6x8 TIMBERS (ITEM #4) SHALL BE ORIENTED WITH THE SHORT DIMENSION VERTICAL, AND A MAX. SPACING OF 2'-6" ON CENTER. (3) 6X8'S SHALL BE LOCATED AT EACH TRACK JOINT AS SHOWN. STAGGER TRACK AND MAT JOINTS 5'-0" MINIMUM.
2. PROVIDE ADDITIONAL CRIBBING AND SHIMS AS NECESSARY TO MAINTAIN A LEVEL TRACK PER SC&RA GUIDELINES. ENSURE CONTINUOUS CONTACT BETWEEN TRACK, 6X8'S, MATS, AND CONCRETE.
3. HARDWARE QUANTITIES MAY BE REDUCED BY 50% WITH A MINIMUM OF (2) BOLTS INSTALLED AT EACH INDIVIDUAL TRACK BOX BEAM CONNECTION.

NO.	REVISIONS	DRAWN DATE	DRAWN BY	CHECKED DATE	CHECKED BY	APPROVED DATE	APPROVED BY
1	LENGTHEN TRACK TO HANDLE KETTLE "G"	12/2/2016	MJA	12/2/2016	MJA	12/2/2016	OPH
0	ORIGINAL ISSUE	11/28/2016	MJA	11/28/2016	MJA	11/30/2016	OPH

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TRACK ASSEMBLY
PLAN & ELEVATION VIEW
EXIDE KETTLE REMOVAL
AMERICAN INTEGRATED SERVICES

SCALE: (U.N.O)	SIZE	PROJECT No.	DWG. No.	SHEET	REV.
1/150	B	10-04-032165	030	2 of 2	1

BIGGE CRANE and RIGGING CO. Established 1916	Page No.: 1 of 39
	Bigge Job No.: 10-06-032165
	Calculation No.: C1
	Revision No.: 0

Project Title:	Exide Kettle Removal		
Calculation Title:	Gantry Analysis		
Prime Contractor:		Contractor Job No.:	
Customer:	American Integrated Services	Customer Ref. No.:	
Prepared by:	Mike Anderson	Date:	11/29/2016
Reviewed by*:	Trace Higgins	Date:	11/30/2016
Approved by:	Trace Higgins	Date:	11/30/2016

REVISION RECORD

Revision Description:	No.:
Prepared by:	Date:
Reviewed by*:	Date:
Approved by:	Date:
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Reviewed by*:	Date:
Approved by:	Date:
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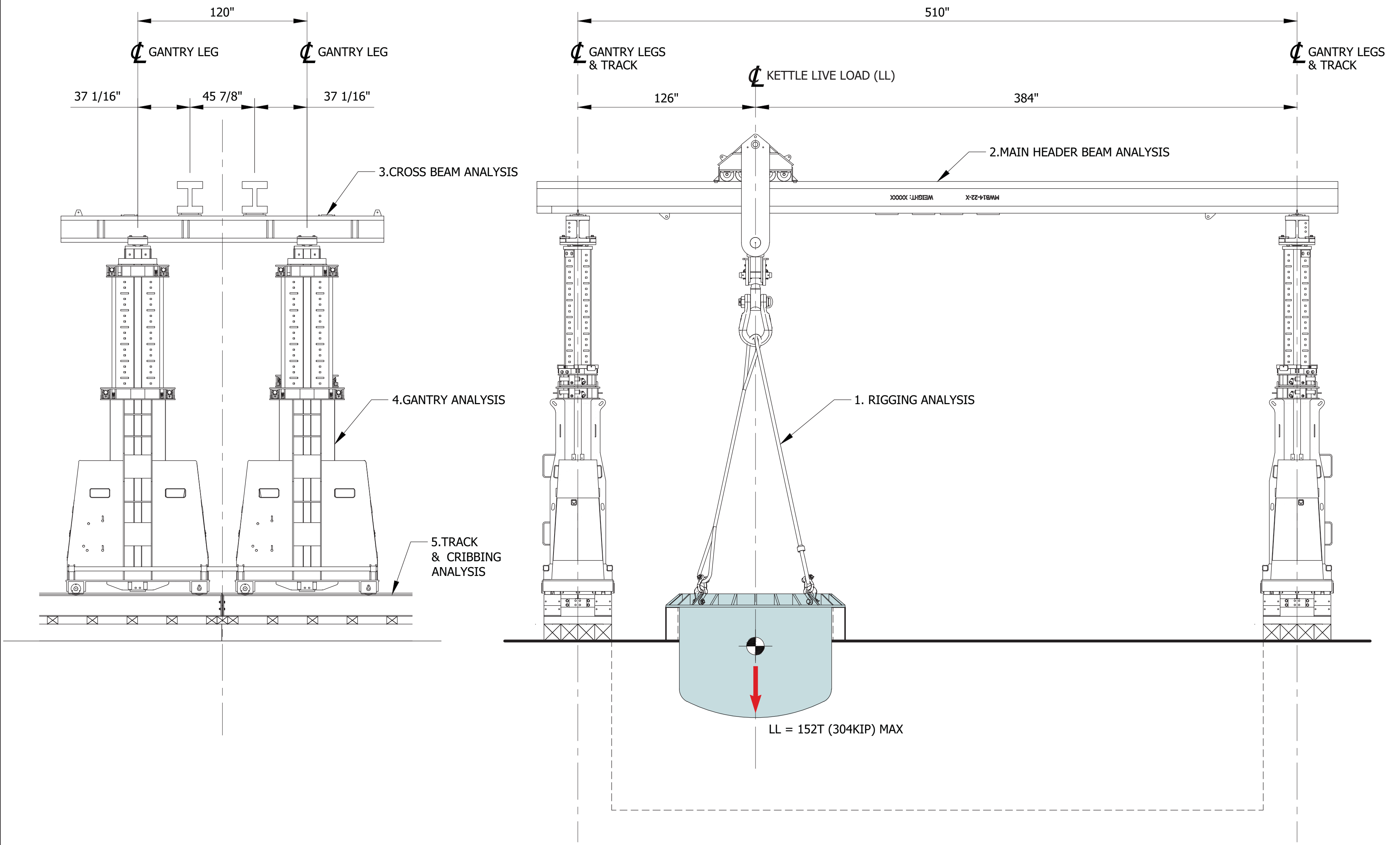
Prepared by:	Date:
Reviewed by*:	Date:
Approved by:	Date:
Additional Notes:	Engineer's Seal:

* Reviewer asserts this calculation is satisfactory by addressing where applicable: (a) correctness of design assumptions, design input, mathematics, computer programs, and output; and (b) suitability of specified materials, parts, processes, inspection and testing.

CONTENT



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SUBJECT: GENERAL OUTLINE OF CALCULATION

FILE: 10-04-032165-C1

BY: MJA

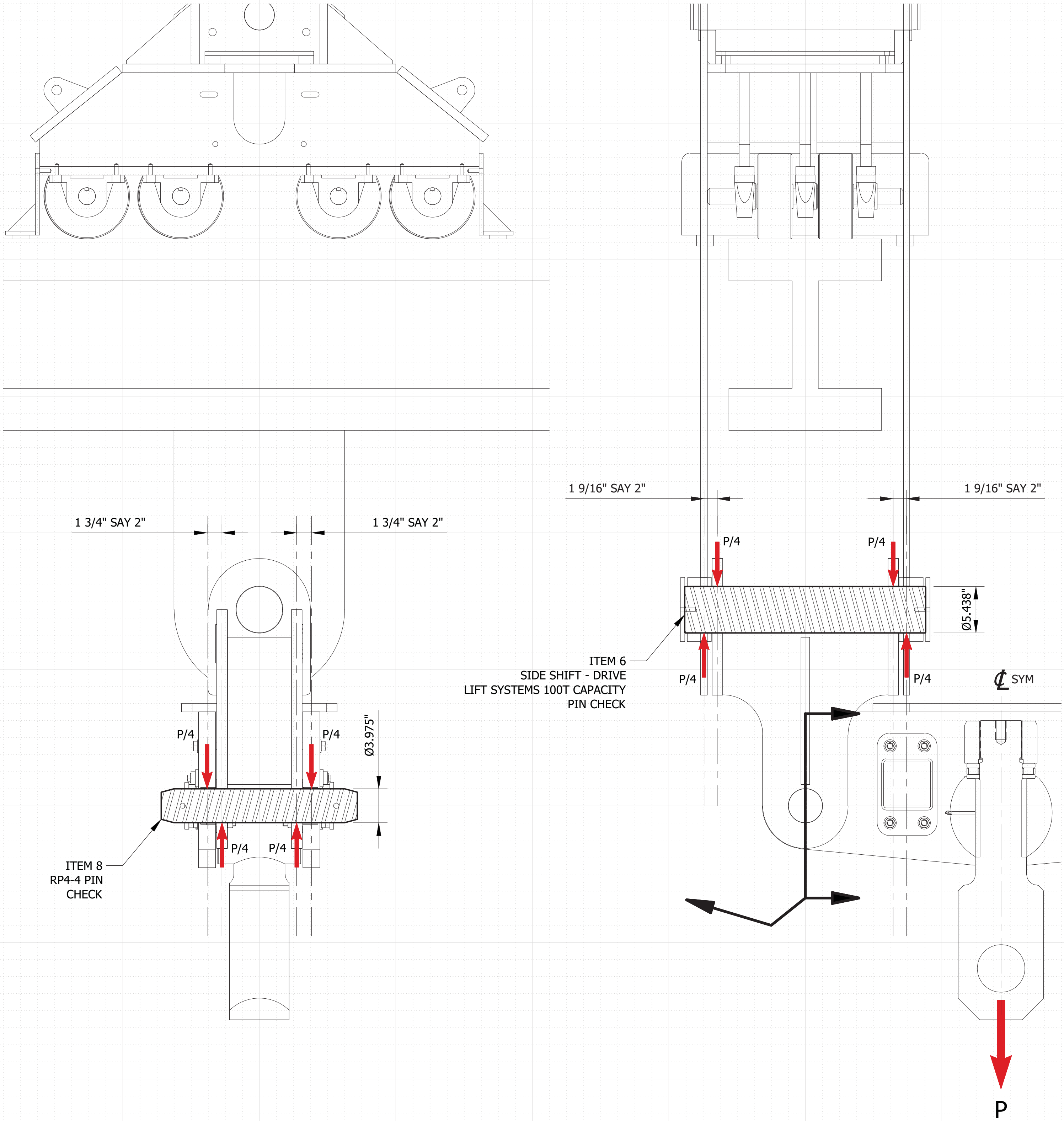
CHK/APP:

DATE: 11/30/16

SHEET: S.1

REVISION: 0

SCALE: 1/100



ITEM 8 & ITEM 6 PIN CHECKS

SCALE: 1/16

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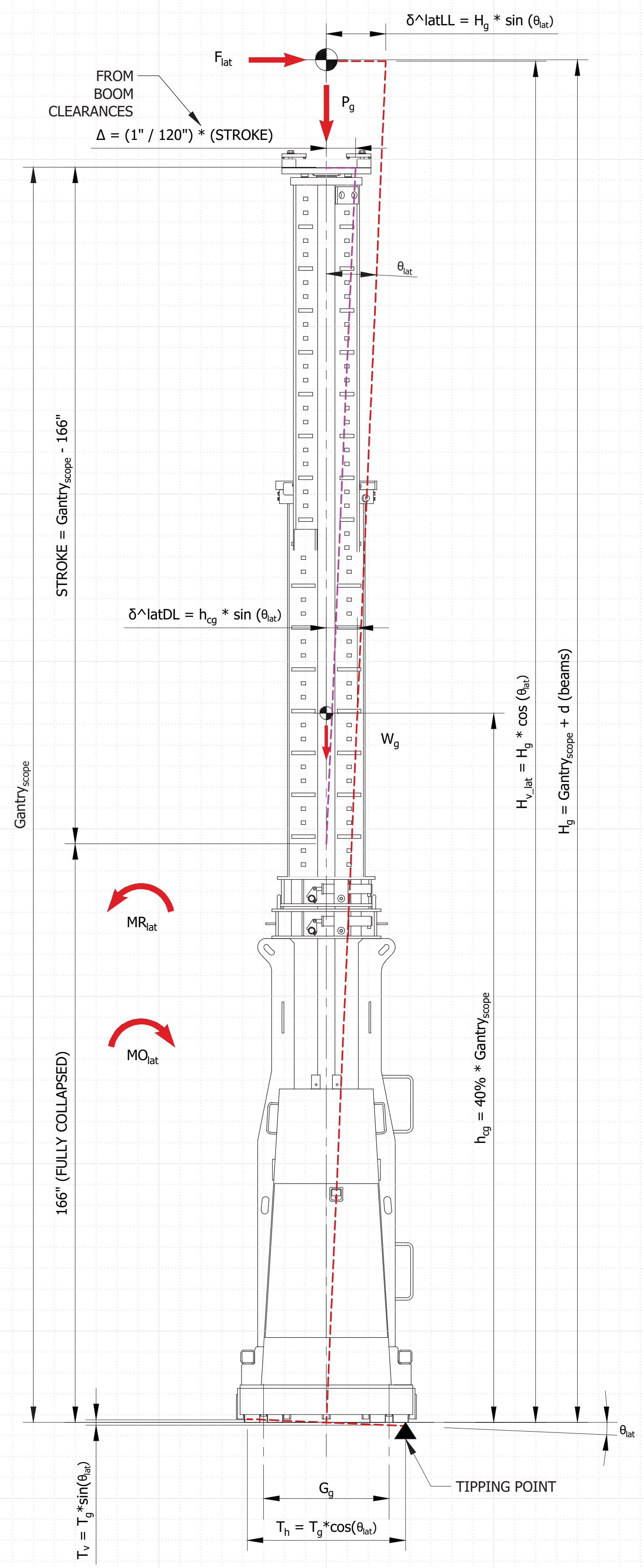
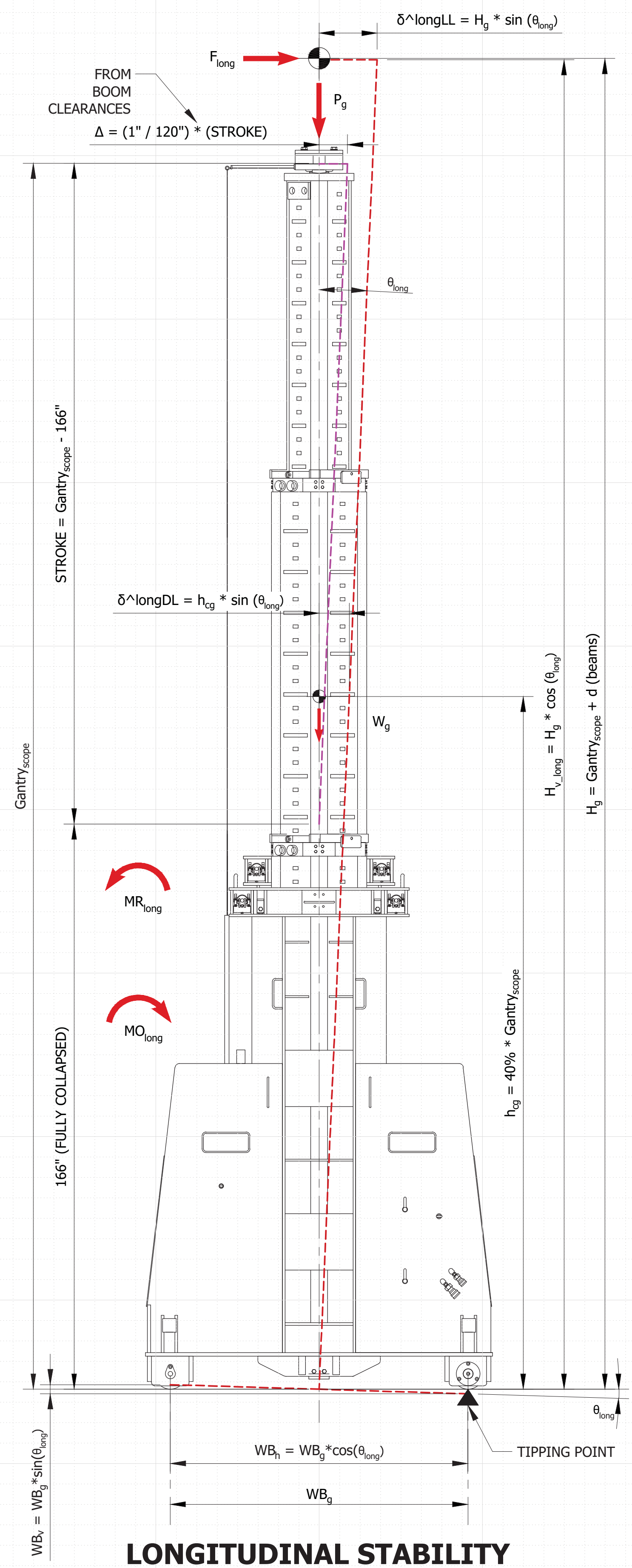
	FILE: 10-04-032165-C1	BY: MJA	CHK/APP:	DATE: 11/30/16	REVISION: 0



LATERAL STABILITY



LONGITUDINAL STABILITY

SCALE: NTS

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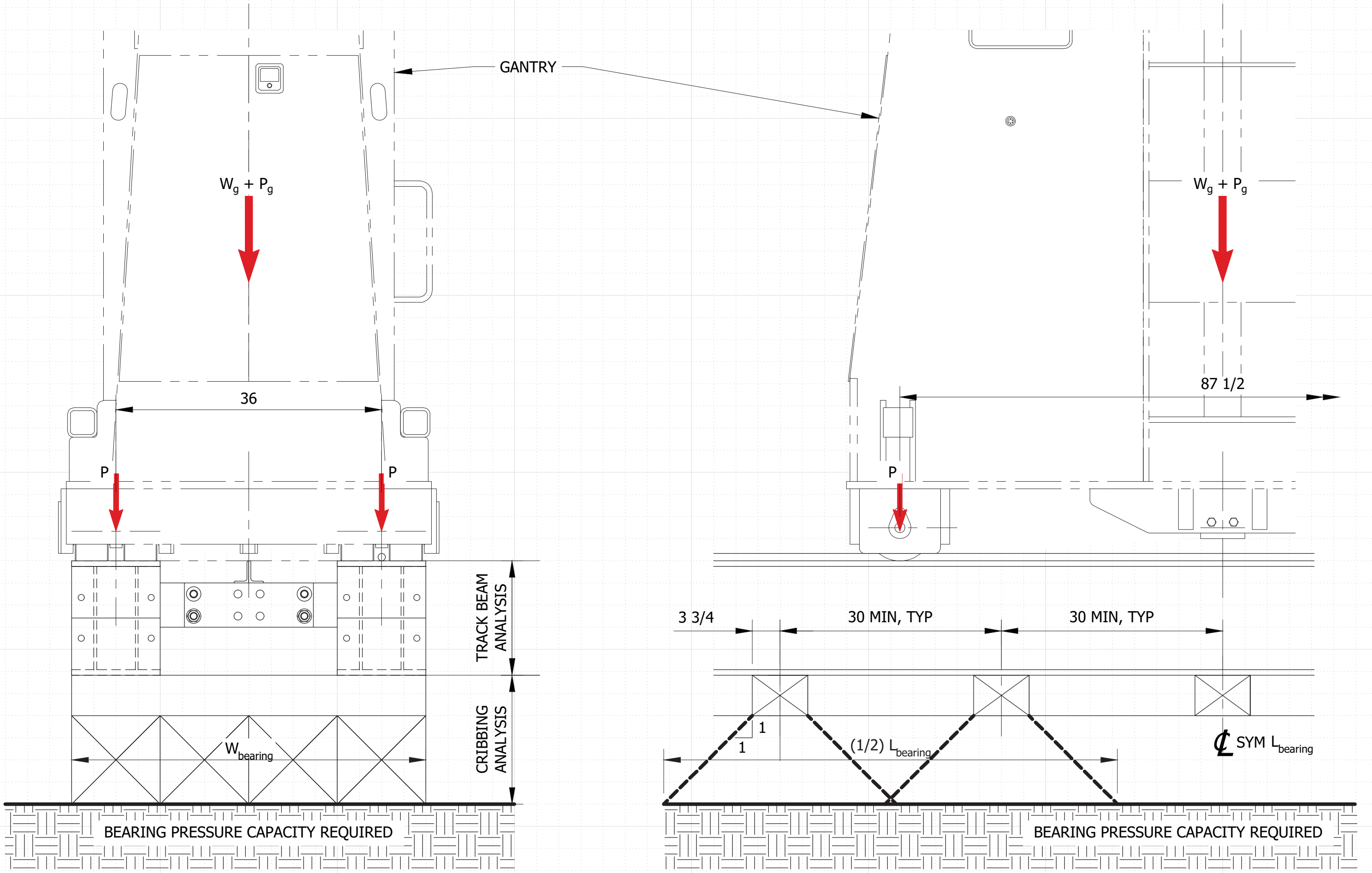
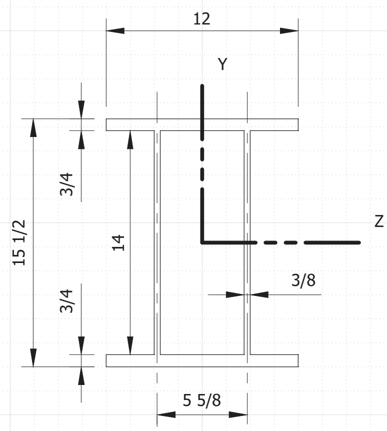
SUBJECT: GANTRY STABILITY ANALYSIS - GENERAL PARAMETERS	SHEET: S.3
FILE: 10-04-032165-C1 | BY: MJA | CHK/APP: | DATE: 11/30/16	REVISION: 0



SCALE: 1/2"=1'-0"



SECTION PROPERTIES

A = 28.5 in^2
Iz = 1151.4 in^4
Iy = 299.2 in^4
Szmax =148.6 in^3
Szmin =148.6 in^3
Symax = 49.9 in^3
Symin = 49.9 in^3
Zz = 169.5 in^3
rz = 6.36 in
ry = 3.24 in

TRACK BEAM SECTION

SCALE: 1"=1'-0"

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SUBJECT: TRACK BEAM & CRIBBING ANALYSIS				SHEET: S.4
FILE: 10-04-032165-C1	BY: MJA	CHK/APP:	DATE: 11/30/16	REVISION: 0

Purpose and Scope

This calculation evaluates Bigge Crane and Rigging Company's hydraulic gantry system and rigging used for lifting and transfering Kettles for the Exide kettle removal project. For this particular project, a 700T Gantry System (HG700 (J&R 1400 Series)) will be used to transfer the components from their original position to the kettle demo area. This calculation will develop loads delivered to the hydraulic gantry system and rigging, then evaluate the system and rigging subject to that load.

Codes and Standards

Gantry Manufacturer Ratings: J&R 1400 Series Hydraulic Gantry (700T Capacity)

ASME B30.20 (Below the Hook Rigging Devices), B30.9 (Slings), B30.26 (Rigging Hardware)

ASME BTH-1, 2011 (Design of Below the Hook Rigging Devices)

AISC, Manual of Steel Construction, 13th Edition

References

Bigge Drawings:

10-04-032165-001 Kettle Lift General Arrangement - Rev 0
10-04-032165-010 Gantry Assembly - Rev 0
10-04-032165-030 Track Assembly - Rev 0
& Associated Bigge Equipment Drawings

Customer Drawings:

V-D6-88 (Vernon - 100 Ton Kettle - Rev 1)
DC-210 - Rev 2 (with customer markups)
DC-211 - Rev 3 (with customer markups)

Load Factors

Lift_Type := "dynamic" ;For setting Dynamic Force Variables based on lifting condition
"static" = lift and set condition
"dynamic" = lift roll and set condition

$I := 110\%$;Vertical Impact Load Factors

$H_{transv} = 5.0 \cdot \%$;Horizontal Misalignment Load (perpendicular to travel)

$H_{long} = 10.0 \cdot \%$;Longitudinal Load Factor (parallel to travel)

Wind Loads

Wind loads on the gantry system structural components are relatively small and considered insignificant compared to other loads. General industry practice considers the exclusion of wind loads from the evaluation to be appropriate as the lifted loads are typically very heavy relative to the effective sail area and lifts are usually performed in wind speeds of 20 mph or less at heights of 40 ft or less.

Load Cases

1. I*LL + DL (vert) — Hoisting
2. I*LL + DL (vert) + H_{transv}*LL (horiz) — Hoisting + Traveling (transverse case)
3. I*LL + DL (vert) + H_{long}*LL (horiz) — Hoisting + Traveling (longitudinal case)

Applicable Constants

$E := 29000\text{ksi}$ $\quad G := 11200\text{ksi}$ $\quad \text{kip} = 1000 \cdot \text{lbf}$ $\quad \text{tonf} = 2\,\text{kip}$ $\quad \text{tonnef} = 2.2\,\text{kip}$ $\quad g = 32.2 \cdot \frac{\text{ft}}{\text{s}^2}$ $\quad T := 2000\text{lbf}$

1. RIGGING ANALYSIS

$Kettle_{WT\_max} := 304kip$ $Rigging_{WT} := 12kip$

;rigging weight (DWG 010) includes items 6 thru 14 + allowance, conservatively added to Kettle weight in rigging analysis

$P := Kettle_{WT\_max} + Rigging_{WT} = 316.0 kip$

$L_{sling} := 15ft + 7in + 9.03in = 196.0 in$

$X_{dim} := 57in$

;distance from shackle pin connection to kettle to cg, TYP

$\theta_h := acos\left(\frac{X_{dim}}{L_{sling}}\right) = 73.1 \cdot deg$

;Angle of sling from horizontal, ~TYP each leg

$P_{sling} := \frac{P}{(4) \cdot sin(\theta_h)} = 82.6 kip$

;Max load to sling, due to rigging configuration all 4 legs share the load, include for sling fleet amplification

IWRC EIPS Ø2 1/4 X 15'-0" - (010) ITEM 11

$d := 2.25in$;Sling nominal diameter

$Nominal_{BS} := 247T = 494.0 \cdot kip$;Nominal breaking strength, EIPS rope

$\eta_{mech\_splice} := 90\%$;Mechanical Splice Effeciency

$DF := 5$;Design Factor, 5:1 for slings

$P_{SLING\_SWL} := \frac{Nominal_{BS} \cdot \eta_{mech\_splice}}{DF} = 88.9 \cdot kip$

Capacity per sling leg $\boxed{\frac{P_{sling}}{P_{SLING\_SWL}} = 0.93}$

IWRC EIPS Ø2 1/2 X 30'-0" - (010) ITEM 12

$d := 2.50in$;Sling nominal diameter

$Nominal_{BS} := 302T = 604.0 \cdot kip$;Nominal breaking strength, EIPS rope

$\eta_{mech\_splice} := 90\%$;Mechanical Splice Effeciency

$DF := 5$;Design Factor, 5:1 for slings

$D := 12.26in$;break over 300T WB Shackle

$R_{D\_d} := \frac{D}{d} = 4.9$;WB break over to sling diameter ratio

$$\eta_{D\_d} := \begin{cases} \left[\left(100 - \frac{76}{R_{D\_d}^{0.73}}\right)\%\right] & \text{if } R_{D\_d} \ge 6.0 \\ \left[\left(100 - \frac{50}{\sqrt{R_{D\_d}}}\right)\%\right] & \text{otherwise} \end{cases} = 77.4 \cdot \%$$

;D/d reduction factor (body of sling over WB)

$P_{SLING\_SWL} := \frac{Nominal_{BS} \cdot min(\eta_{D\_d}, \eta_{mech\_splice})}{DF} = 93.5 \cdot kip$

Capacity per sling leg $\boxed{\frac{P_{sling}}{P_{SLING\_SWL}} = 0.88}$

40T SHACKLES - (010) ITEM 13 & ITEM 14

$Shackle_{40t\_cap} := 40tonnef = 88.2 kip$

$\boxed{\frac{P_{sling}}{Shackle_{40t\_cap}} = 0.94}$

300T SHACKLE - (010) ITEM 10

$Shackle_{300t\_cap} := 300tonnef = 661.4kip$

$$\boxed{\frac{P}{Shackle_{300t\_cap}} = 0.48}$$

SB-187 250T SWIVEL SPREADER - (010) ITEM 9

$SB\_187_{250t\_cap} := 250T = 500.0kip$

$$\boxed{\frac{P}{SB\_187_{250t\_cap}} = 0.63}$$

RP4-4 PIN CHECK - (010) ITEM 8

$F_y := 90ksi \qquad F_u := 100ksi$

$D_p := 3.97in$

$N_d := 2.00$;Design Category A, Service Class 0

$V_{max} := \frac{P}{4} = 79.0kip \qquad M_{max} := V_{max} \cdot 2in = 158.0 \cdot kip \cdot in$;simple span max internal loads

CALCULATED PROPERTIES OF PIN

$A_g := \frac{\pi}{4} \cdot D_p^{\,2} = 12.4 \cdot in^2 \qquad S := \frac{\pi}{32} \cdot D_p^{\,3} = 6.14 \cdot in^3$

CALCULATED STRENGTHS

$f_b := \frac{M_{max}}{S} = 25.7 \cdot ksi \qquad F_b := \frac{1.25 \cdot F_y}{N_d} = 56.2 \cdot ksi \qquad \boxed{\frac{f_b}{F_b} = 0.46}$

$f_v := \frac{4}{3} \cdot \frac{V_{max}}{A_g} = 8.5 \cdot ksi \qquad F_v := \frac{F_y}{N_d \cdot \sqrt{3}} = 26.0 \cdot ksi \qquad \boxed{\frac{f_v}{F_v} = 0.33}$

RL90-17 100T 90° LINK - (010) ITEM 7 CHECK

$RL90\_17_{100t\_cap} := 100T = 200.0kip$

$$\boxed{\frac{\frac{P}{2}}{RL90\_17_{100t\_cap}} = 0.79}$$

SIDE SHIFT - DRIVE - LIFT SYSTEMS 100T CAPACITY - PIN CHECK - (010) ITEM 6

$F_y := 85ksi \qquad F_u := 100ksi$;ASTM A193 GRB16 HR&HT

$D_p := 5.438in$

$N_d := 2.00$;Design Category A, Service Class 0

$V_{max} := \frac{P}{4} = 79.0kip \qquad M_{max} := V_{max} \cdot 2in = 158.0 \cdot kip \cdot in$;simple span max internal loads

CALCULATED PROPERTIES OF PIN

$A_g := \frac{\pi}{4} \cdot D_p^{\,2} = 23.2 \cdot in^2 \qquad S := \frac{\pi}{32} \cdot D_p^{\,3} = 15.79 \cdot in^3$

CALCULATED STRENGTHS

$f_b := \frac{M_{max}}{S} = 10.0 \cdot ksi$

$F_b := \frac{1.25 \cdot F_y}{N_d} = 53.1 \cdot ksi$

$\boxed{\frac{f_b}{F_b} = 0.19}$

$f_v := \frac{4}{3} \cdot \frac{V_{max}}{A_g} = 4.5 \cdot ksi$

$F_v := \frac{F_y}{N_d \cdot \sqrt{3}} = 24.5 \cdot ksi$

$\boxed{\frac{f_v}{F_v} = 0.18}$

<u>SIDE SHIFT - DRIVE - LIFT SYSTEMS 100T CAPACITY - GENERAL CHECK - (010) ITEM 6</u>

$LIFT\_SYS\_SS_{100t\_cap} := 100T = 200.0 kip$

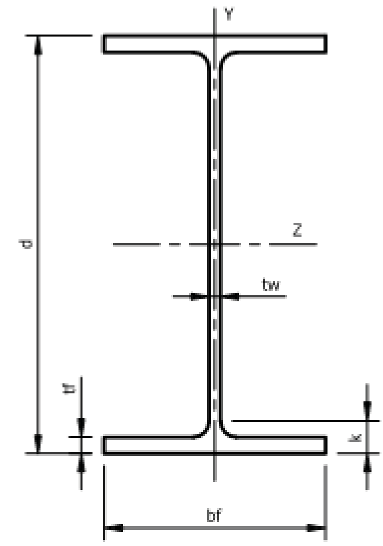
$\boxed{\frac{\frac{P}{2}}{LIFT\_SYS\_SS_{100t\_cap}} = 0.79}$

The indicated rigging is acceptable. Kettle rigging points to be modified by others as necessary to facilitate the indicated shackle connection and safe handling of the kettles per Bigge DWG 010.

2. Main Header Beam Analysis

MEMBER = "Main Header Beam"   SHAPE = "W14X730"   LOADCASE = "MAX DEVELOPED"

Section and Material Properties



$d = 22.40\,in$	$I_y = 4720.0 \cdot in^4$	$I_z = 14300.0 \cdot in^4$
$t_w = 3.07\,in$	$S_y = 527.0 \cdot in^3$	$S_z = 1280.0 \cdot in^3$
$b_f = 17.90\,in$	$r_y = 4.69\,in$	$r_z = 8.17\,in$
$t_f = 4.91\,in$	$Z_y = 816.0 \cdot in^3$	$Z_z = 1660.0 \cdot in^3$
$A_g = 215.0 \cdot in^2$	$J_x = 1450.0 \cdot in^4$	$r_{ts} = 5.68\,in$
$A_{vy} := d \cdot t_w = 68.8 \cdot in^2$	$k_{des} = 5.51\,in$	$C_w = 362000.0 \cdot in^6$
$A_{vz} := 2 \cdot b_f \cdot t_f = 175.8 \cdot in^2$	$h_0 = 17.49\,in$	$h = 11.38\,in$
$F_y := 50ksi$	$F_u := 65ksi$	$E = 29000.0 \cdot ksi$

Check Width-Thickness Ratios

CONFIRM ALL ELEMENTS OF THIS SECTION ARE COMPACT FOR BENDING AND SHEAR AND NON-NONSLENDER FOR COMPRESSION, USING AISC TABLE B4.1 OR AS NOTED:

$\lambda_{flange} = 1.82$

$\lambda_{web} = 3.71$

AISC Case 1 $\lambda_{p\_flange\_bend} := 0.38 \cdot \sqrt{E \div F_y} = 9.15$ $is(\lambda_{flange} \le \lambda_{p\_flange\_bend})$ = "Yes, OK"

AISC Case 3 $\lambda_{r\_flange\_compr} := 0.56 \cdot \sqrt{E \div F_y} = 13.49$ $is(\lambda_{flange} \le \lambda_{r\_flange\_compr})$ = "Yes, OK"

AISC Case 9 $\lambda_{p\_web\_bend} := 3.76 \cdot \sqrt{E \div F_y} = 90.55$ $is(\lambda_{web} \le \lambda_{p\_web\_bend})$ = "Yes, OK"

AISC Case 10 $\lambda_{r\_web\_compr} := 1.49 \cdot \sqrt{E \div F_y} = 35.88$ $is(\lambda_{web} \le \lambda_{r\_web\_compr})$ = "Yes, OK"

AISC G2.1a $\lambda_{web\_shear\_yield} := 2.24 \cdot \sqrt{E \div F_y} = 53.95$ $is(\lambda_{web} \le \lambda_{web\_shear\_yield})$ = "Yes, OK"

MEMBER = "Main Header Beam" SHAPE = "W14X730" LOADCASE = "MAX DEVELOPED"

Header Beam Internal Loads

$Span := 42.5ft = 510.0\,in$

$L_{HB} := 47.33ft$;length of header beam

$Wt_{HB} := 36kip$;weight allowance for header beam

$w_{HB} := \frac{Wt_{HB}}{L_{HB}} = 761 \cdot \frac{lbf}{ft}$;allowance of dist load for header beam

$Kettle_{WT\_max} = 304.0\,kip$

$Rigging_{WT} = 12.0\,kip$

$a := 384in$ $b := 126in$ $L_{span} := 510in$

$I = 110.0 \cdot \%$ $H_{transv} = 5.0 \cdot \%$ $H_{long} = 10.0 \cdot \%$

$$P_y := \frac{\left(Kettle_{WT\_max} + Rigging_{WT}\right) \cdot I}{2} = 173.8 \cdot kip$$

$$V_{ay} := P_y \cdot \left(\frac{a}{L_{span}}\right) + \frac{Wt_{HB}}{2} = 148.9 \cdot kip$$

$$M_{az} := V_{ay} \cdot b + \frac{w_{HB} \cdot Span^2}{8} = 20817.3 \cdot kip \cdot in$$

$$P_{ax} := \left(\frac{Kettle_{WT\_max} + Rigging_{WT}}{2}\right) \cdot H_{transv} = 7.9 \cdot kip$$

$$T_{ax} := 0kip \cdot in$$

$$V_{az} := \left(\frac{Kettle_{WT\_max} + Rigging_{WT}}{2}\right) \cdot \left(\frac{a}{L_{span}}\right) \cdot H_{long} = 11.9 \cdot kip$$

$$M_{ay} := V_{az} \cdot b = 1499.0 \cdot kip \cdot in$$

MEMBER = "Main Header Beam" SHAPE = "W14X730" LOADCASE = "MAX DEVELOPED"

Beam-Column Geometry

Stiffener := "no" Bracing := "no"

$L_{span} = 510.0\,in$ $L_b := L_{span} = 510.0\,in$;Lb of span if stiffeners, or Lb of bracing if provided

$$L_{span} + \frac{d}{6}\cdot\left(\frac{t_f}{t_w}\right)^3 = 525.3\,in$$

$$L_b := \begin{cases} L_b & \text{if Stiffener = "yes"} \vee \text{Bracing = "yes"} \\ \left[L_{span} + \frac{d}{6}\cdot\left(\frac{t_f}{t_w}\right)^3\right] & \text{if Stiffener = "no"} \wedge \text{Bracing = "no"} \wedge \frac{d}{t_w} < 100 \wedge \frac{b_f}{d} < 1 \\ \text{"NG"} & \text{otherwise} \end{cases} = 525.3\,in$$

$L_b = 525.3\,in$ $C_b := 1$

$L_y := L_b = 525.3\,in$ $K_y := 1$

$L_z := L_b = 525.3\,in$ $K_z := 1$

$L_w := L_b = 525.3\,in$

Compression Design Strength (Pnx_Ω) - AISC E3

Slenderness Ratios

$K_y = 1.0$ $L_y = 525.3\,in$ $K_z = 1.0$ $L_z = 525.3\,in$

$\Psi_y := \frac{K_y \cdot L_y}{r_y} = 112.0$ $\Psi_z := \frac{K_z \cdot L_z}{r_z} = 64.3$ $\Psi := \max(\Psi_z, \Psi_y) = 112.0$

$$\Psi_r := 4.71\cdot\sqrt{\frac{E}{F_y}} = 113.4$$

Strength

$\Omega_c := 1.67$

$F_e := \frac{\pi^2 \cdot E}{\Psi^2} = 22.8\cdot ksi$

$$F_{cr} := \begin{cases} \left(0.658^{\frac{F_y}{F_e}}\right)\cdot F_y & \text{if } \Psi \le \Psi_r \\ 0.877\cdot F_e & \text{otherwise} \end{cases} = 20\cdot ksi$$

$A_g = 215.0\cdot in^2$

$$\boxed{P_{nx\_\Omega} := \frac{F_{cr}\cdot A_g}{\Omega_c} = 2573\,kip}$$

MEMBER = "Main Header Beam"   SHAPE = "W14X730"   LOADCASE = "MAX DEVELOPED"

Shear Strength Web (Vny_Ω) - AISC CHAPTER G

$E = 29000.0 \cdot ksi$ $F_y = 50.0 \cdot ksi$

$h = 11.4 in$ $t_w = 3.1 in$

$\lambda_{web} = 3.7$ $A_{vy} = 68.8 \cdot in^2$

transverse_stiffeners := "no"   ;either "no" or "yes"

a := 1in   ;transverse stiffener spacing

$$k_v := \left| \begin{array}{l} k_v \leftarrow 5 \;\; \text{if transverse\_stiffeners} = \text{"no"} \wedge \lambda_{web} < 260 \\ k_v \leftarrow 5 + \dfrac{5}{\left(\frac{a}{h}\right)^2} \;\; \text{if transverse\_stiffeners} = \text{"yes"} \\ k_v \leftarrow 5 \;\; \text{if transverse\_stiffeners} = \text{"yes"} \wedge \left[\frac{a}{h} > 3.0 \vee \frac{a}{h} > \left[\dfrac{260}{\left(\frac{h}{t_w}\right)}\right]^2\right] \\ k_v \leftarrow \text{"Web too Slender, Redesign"} \;\; \text{if } \lambda_{web} \geq 260 \\ \text{return } k_v \end{array} \right. = 5.0$$

$$C_{vy} := \left| \begin{array}{l} C_v \leftarrow 1.0 \;\; \text{if } \lambda_{web} \leq 2.24 \cdot \sqrt{\frac{E}{F_y}} \\ C_v \leftarrow 1.0 \;\; \text{if } \lambda_{web} \leq 1.10 \cdot \sqrt{\frac{k_v \cdot E}{F_y}} \\ C_v \leftarrow \dfrac{1.10 \cdot \sqrt{\frac{k_v \cdot E}{F_y}}}{\lambda_{web}} \;\; \text{if } 1.10 \cdot \sqrt{\frac{k_v \cdot E}{F_y}} < \lambda_{web} \leq 1.37 \cdot \sqrt{\frac{k_v \cdot E}{F_y}} \\ C_v \leftarrow \dfrac{1.51 \cdot E \cdot k_v}{\lambda_{web}^2 \cdot F_y} \;\; \text{if } \lambda_{web} > 1.37 \cdot \sqrt{\frac{k_v \cdot E}{F_y}} \\ \text{return } C_v \end{array} \right. = 1.0$$

$V_{ny} := 0.6 \cdot F_y \cdot A_{vy} \cdot C_{vy} = 2063.0 kip$

Strength

$$\Omega_v := \left| \begin{array}{l} \Omega_v \leftarrow 1.50 \;\; \text{if } \lambda_{web} \leq 2.24 \cdot \sqrt{\frac{E}{F_y}} \\ \Omega_v \leftarrow 1.67 \;\; \text{if } \lambda_{web} > 2.24 \cdot \sqrt{\frac{E}{F_y}} \end{array} \right. = 1.5$$

$$\boxed{V_{ny\_\Omega} := \frac{V_{ny}}{\Omega_v} = 1375 \cdot kip}$$

MEMBER = "Main Header Beam" SHAPE = "W14X730" LOADCASE = "MAX DEVELOPED"

Shear Strength - Flanges (Vnz_Ω) - AISC SECTION G7

$\Omega_{vz} := 1.67$ $A_{vz} = 175.8 \cdot in^2$ $F_y = 50.0 \cdot ksi$

$C_{vz} := 1.0$

$V_{nz} := (0.6 \cdot F_y) \cdot A_{vz} \cdot C_{vz} = 5273 kip$

$$\boxed{V_{nz\_\Omega} := \frac{V_{nz}}{\Omega_{vz}} = 3158 \cdot kip}$$

Bending Strength - Strong Axis (Mnz_Ω) - AISC F2

Span Geometry

$L_b = 525.3 in$ $C_b = 1.00$ $L_b = 43.8 \cdot ft$

Limiting Lengths

$L_p := 1.76 \cdot \sqrt{\frac{E}{F_y}} \cdot r_y = 198.8 in$ $c := 1.0$ $L_p = 16.6 \cdot ft$

$$L_r := 1.95 \cdot r_{ts} \cdot \frac{E}{0.7 \cdot F_y} \cdot \sqrt{\frac{J_x \cdot c}{S_z \cdot h_0}} \cdot \sqrt{1 + \sqrt{1 + 6.76 \cdot \left(\frac{0.7 \cdot F_y}{E} \cdot \frac{S_z \cdot h_0}{J_x \cdot c}\right)^2}} = 3306 \cdot in$$

$L_r = 275.5 \cdot ft$

Strength

$\Omega_b := 1.67$

$M_{pz} := F_y \cdot Z_z = 83000 \cdot kip \cdot in$

$M_{rz} := 0.7 F_y \cdot S_z = 44800 \cdot kip \cdot in$

$$M_{nz} := \begin{cases} M_{pz} & \text{if } L_b \le L_p \\ \min\left[C_b \cdot \left[M_{pz} - (M_{pz} - M_{rz})\left(\frac{L_b - L_p}{L_r - L_p}\right)\right], M_{pz}\right] & \text{if } L_p < L_b \le L_r \\ \min\left[S_z \cdot \left[\frac{C_b \cdot \pi^2 \cdot E}{\left(\frac{L_b}{r_{ts}}\right)^2} \cdot \sqrt{1 + 0.078 \cdot \frac{J_x \cdot c}{S_z \cdot h_0} \cdot \left(\frac{L_b}{r_{ts}}\right)^2}\right], M_{pz}\right] & \text{otherwise} \end{cases} = 78986 \cdot kip \cdot in$$

$$\boxed{M_{nz\_\Omega} := \frac{M_{nz}}{\Omega_b} = 47297 \cdot kip \cdot in}$$

MEMBER = "Main Header Beam" SHAPE = "W14X730" LOADCASE = "MAX DEVELOPED"

Bending Strength - Weak Axis (Mny_Ω) - AISC F6

;take weak bending into 1 flange

$t_f = 4.91\,in$ $b_f = 17.90\,in$ $S_{flange} := \frac{t_f \cdot b_f^2}{6} = 262.2 \cdot in^3$ $Z_{flange} := \frac{t_f \cdot b_f^2}{4} = 393.3 \cdot in^3$

$M_{p\_flange} := F_y \cdot Z_{flange} = 19665 \cdot kip \cdot in$ $M_{y\_flange} := 1.6 F_y \cdot S_{flange} = 20976 \cdot kip \cdot in$

$M_{ny} := \min\left(M_{p\_flange}, M_{y\_flange}\right) = 19665 \cdot kip \cdot in$

$\boxed{M_{ny\_\Omega} := \frac{M_{ny}}{\Omega_b} = 11776 \cdot kip \cdot in}$

MEMBER = "Main Header Beam" SHAPE = "W14X730" LOADCASE = "MAX DEVELOPED"

Axial Compression & Flexure Strength Ratios

$P_{nx\_\Omega} = 2572.6 \cdot kip$ $P_{ax} = 7.9 \cdot kip$ $SR_{Px} := \dfrac{P_{ax}}{P_{nx\_\Omega}} = 0.00$

$M_{ny\_\Omega} = 11775.5 \cdot kip \cdot in$ $M_{ay} = 1499.0 \cdot kip \cdot in$ $SR_{My} := \dfrac{M_{ay}}{M_{ny\_\Omega}} = 0.13$

$M_{nz\_\Omega} = 47296.8 \cdot kip \cdot in$ $M_{az} = 20817.3 \cdot kip \cdot in$ $SR_{Mz} := \dfrac{M_{az}}{M_{nz\_\Omega}} = 0.44$

Shear Strength Ratios

$V_{ny\_\Omega} = 1375.4 kip$ $V_{ay} = 148.9 kip$ $SR_{Vy} := \dfrac{V_{ay}}{V_{ny\_\Omega}} = 0.11$

$V_{nz\_\Omega} = 3157.7 kip$ $V_{az} = 11.9 kip$ $SR_{Vz} := \dfrac{V_{az}}{V_{nz\_\Omega}} = 0.00$

MEMBER = "Main Header Beam" SHAPE = "W14X730" LOADCASE = "MAX DEVELOPED"

Axial Compression + Flexure Interation Ratio (AISC H1)

$$IR_{H1\_1} := \begin{cases} \dfrac{P_{ax}}{P_{nx\_\Omega}} + \dfrac{8}{9}\cdot\left(\dfrac{M_{ay}}{M_{ny\_\Omega}} + \dfrac{M_{az}}{M_{nz\_\Omega}}\right) & \text{if } \max\left(\dfrac{P_{ax}}{P_{nx\_\Omega}}\right) \geq 0.2 \\ \dfrac{1}{2}\dfrac{P_{ax}}{P_{nx\_\Omega}} + \left(\dfrac{M_{ay}}{M_{ny\_\Omega}} + \dfrac{M_{az}}{M_{nz\_\Omega}}\right) & \text{otherwise} \end{cases} = 0.57$$

$\boxed{is\left(\max\left(IR_{H1\_1}\right) \leq 1.0\right) = \text{"Yes, OK"}}$

$$\frac{P_{ax}}{P_{nx\_\Omega}} + \frac{8}{9}\cdot\left(\frac{M_{ay}}{M_{ny\_\Omega}} + \frac{M_{az}}{M_{nz\_\Omega}}\right) = 0.51$$

;for reference

$$\frac{1}{2}\frac{P_{ax}}{P_{nx\_\Omega}} + \left(\frac{M_{ay}}{M_{ny\_\Omega}} + \frac{M_{az}}{M_{nz\_\Omega}}\right) = 0.57$$

Deflection - Center Span

$L := L_{span} = 510.0\,in$ $I_z = 14300.0\cdot in^4$ $E = 29000.0\cdot ksi$ $Kettle_{WT\_max} = 304.0\,kip$

$a := 384in$ $b := 126in$ $Rigging_{WT} = 12.0\,kip$

$w_{HB} = 760.6\cdot\dfrac{lbf}{ft}$

$$P := \frac{Kettle_{WT\_max} + Rigging_{WT}}{2} = 158.0\cdot kip$$

$$\delta\_y := \frac{P\cdot a\cdot b\cdot(a + 2\cdot b)\cdot\sqrt{3\cdot a\cdot(a + 2\cdot b)}}{27\cdot E\cdot I_z\cdot L} + \frac{5\cdot w_{HB}\cdot L^4}{384\cdot E\cdot I_z} = 0.86in$$

$$\frac{L}{\delta\_y} = 590.7$$

$\boxed{is\left(\dfrac{L}{\delta\_y} > 480\right) = \text{"Yes, OK"}}$

MEMBER = "Main Header Beam"   SHAPE = "W14X730"   LOADCASE = "MAX DEVELOPED"

Concentrated Load Checks - End Reactions

cf_restrain := "no"   ;if the compression flange is restained against rotation - "yes"
if the compression flange is not restrained against rotation - "no"

stiff_R := "no"   ;if bearing stiffeners provided - "yes"
if bearing stiffeners not provided - "no"

$d = 22.40\,in$ $t_w = 3.07\,in$ $t_f = 4.91\,in$ $k_{des} = 5.51\,in$ $F_y = 50.0\cdot ksi$ $F_u = 65.0\cdot ksi$ $E = 29000.00\cdot ksi$

$L_{Load} := \frac{L_{HB} - L_{span}}{2} = 29.0\,in$;distance of load from the end of the member

$N := 0in$;length of bearing (conservative)

$V_{ay} = 148.9\,kip$ $R_{max} := \max(V_{ay}) = 148.9\,kip$;max reaction at leg

Web Local Yielding (AISC J10.2)

$\Omega_{J10.2} := 1.50$ $k_{des} = 5.51\,in$ $N = 0.0$ $F_y = 50.0\cdot ksi$ $t_w = 3.07\,in$ $L_{Load} = 28.98\,in$ $d = 22.40\,in$

$$R_{n\_J10.2} := \left| \begin{array}{ll} \left[(5\cdot k_{des} + N)\cdot F_y\cdot t_w\right] & \text{if } L_{Load} > d \\ \left[(2.5\cdot k_{des} + N)\cdot F_y\cdot t_w\right] & \text{otherwise} \end{array} \right. = 4228.9\,kip$$

$$R_{n\_J10.2\_\Omega} := \frac{R_{n\_J10.2}}{\Omega_{J10.2}} = 2819.3\,kip$$

$$\boxed{\frac{R_{max}}{R_{n\_J10.2\_\Omega}} = 0.05}$$

Web Crippling (AISC J10.3)

$\Omega_{J10.3} := 2.00$ $t_w = 3.07\,in$ $N = 0.0$ $d = 22.40\,in$ $t_f = 4.91\,in$ $E = 29000.0\cdot ksi$ $F_y = 50.0\cdot ksi$ $L_{Load} = 28.98\,in$

$$R_{n\_J10.3} := \left| \begin{array}{l} \left[0.80\cdot t_w^{\,2}\cdot\left[1 + 3\cdot\left(\frac{N}{d}\right)\cdot\left(\frac{t_w}{t_f}\right)^{1.5}\right]\cdot\sqrt{\frac{E\cdot F_y\cdot t_f}{t_w}}\right] \text{ if } L_{Load} \ge \frac{d}{2} \\ \text{otherwise} \\ \quad \left| \begin{array}{l} 0.40\cdot t_w^{\,2}\cdot\left[1 + 3\cdot\left(\frac{N}{d}\right)\cdot\left(\frac{t_w}{t_f}\right)^{1.5}\right]\cdot\sqrt{\frac{E\cdot F_y\cdot t_f}{t_w}} \text{ if } \frac{N}{d} \le 0.2 \\ 0.40\cdot t_w^{\,2}\cdot\left[1 + \left(\frac{4N}{d} - 0.2\right)\cdot\left(\frac{t_w}{t_f}\right)^{1.5}\right]\cdot\sqrt{\frac{E\cdot F_y\cdot t_f}{t_w}} \text{ if } \frac{N}{d} > 0.2 \end{array} \right. \end{array} \right. = 11482.1\,kip$$

$$R_{n\_J10.3\_\Omega} := \frac{R_{n\_J10.3}}{\Omega_{J10.3}} = 5741.1\,kip$$

$$\boxed{\frac{R_{max}}{R_{n\_J10.3\_\Omega}} = 0.03}$$

MEMBER = "Main Header Beam" SHAPE = "W14X730" LOADCASE = "MAX DEVELOPED"

Web Sidesway Buckling (AISC J10.4)

$\Omega_{J10.4} := 1.76$ $t_w = 3.07in$ $N = 0.0$ $d = 22.40in$ $t_f = 4.91in$ $E = 29000.0\cdot ksi$ $F_y = 50.0\cdot ksi$ $L_{Load} = 28.98in$

$h = 11.4in$ $l := L_b = 525.3in$

cf_restrain = "no" ;if the compression flange is restained against rotation - "yes"
if the compression flange is not restrained against rotation - "no"

stiff_R = "no" ;if bearing stiffeners provided - "yes"
if bearing stiffeners not provided - "no"

$M_{az} = 20817.3\cdot kip\cdot in$ $M_z := \max(M_{az}) = 20817.3\cdot kip\cdot in$ $M_y := S_z\cdot F_y = 64000.0\cdot kip\cdot in$

$$C_r := \begin{cases} 960000ksi & \text{if } 1.5\cdot M_z < M_y \\ 480000ksi & \text{if } 1.5\cdot M_z \ge M_y \end{cases} = 960000.0\cdot ksi$$

$$\left(\frac{h}{t_w}\right) \div \left(\frac{l}{b_f}\right) = 0.13$$;for reference

$$R_{n\_J10.4} := \begin{cases} \text{if cf\_restrain} = \text{"yes"} \\ \quad \begin{cases} \dfrac{C_r\cdot t_w^{3}\cdot t_f}{h^2}\cdot\left[1+0.4\cdot\left(\dfrac{\frac{h}{t_w}}{\frac{l}{b_f}}\right)^3\right] & \text{if } \left(\frac{h}{t_w}\right)\div\left(\frac{l}{b_f}\right) \le 2.3 \\ \text{"J10.4 does not apply"} & \text{if } \left(\frac{h}{t_w}\right)\div\left(\frac{l}{b_f}\right) > 2.3 \end{cases} \\ \text{if cf\_restrain} = \text{"no"} \\ \quad \begin{cases} \dfrac{C_r\cdot t_w^{3}\cdot t_f}{h^2}\cdot\left[0.4\cdot\left(\dfrac{\frac{h}{t_w}}{\frac{l}{b_f}}\right)^3\right] & \text{if } \left(\frac{h}{t_w}\right)\div\left(\frac{l}{b_f}\right) \le 1.7 \\ \text{"J10.4 does not apply"} & \text{if } \left(\frac{h}{t_w}\right)\div\left(\frac{l}{b_f}\right) > 1.7 \end{cases} \end{cases} = 849.1kip$$

$$R_{n\_J10.4\_\Omega} := \frac{R_{n\_J10.4}}{\Omega_{J10.4}} = 482.4kip$$

$$\boxed{\frac{R_{max}}{R_{n\_J10.4\_\Omega}} = 0.31}$$

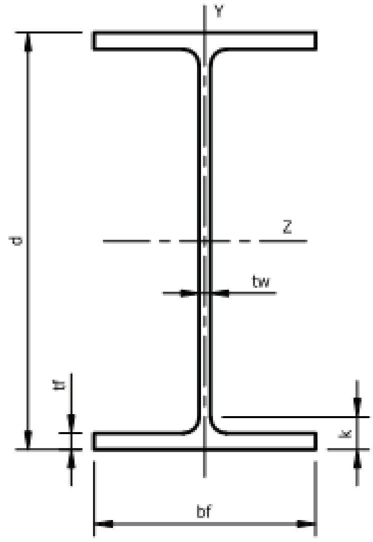
SUMMARY = "All applicable concentrated load checks OK without stiffeners"

3. Cross Beam Analysis

MEMBER = "Cross Beam"　　SHAPE = "W14X426"　　LOADCASE = "MAX DEVELOPED"

Section and Material Properties

$d = 18.70\,in$	$I_y = 2360.0 \cdot in^4$	$I_z = 6600.0 \cdot in^4$
$t_w = 1.88\,in$	$S_y = 283.0 \cdot in^3$	$S_z = 706.0 \cdot in^3$
$b_f = 16.70\,in$	$r_y = 4.34\,in$	$r_z = 7.26\,in$
$t_f = 3.04\,in$	$Z_y = 434.0 \cdot in^3$	$Z_z = 869.0 \cdot in^3$
$A_g = 125.0 \cdot in^2$	$J_x = 331.0 \cdot in^4$	$r_{ts} = 5.11\,in$
$A_{vy} := d \cdot t_w = 35.2 \cdot in^2$	$k_{des} = 3.63\,in$	$C_w = 144000.0 \cdot in^6$
$A_{vz} := 2 \cdot b_f \cdot t_f = 101.5 \cdot in^2$	$h_0 = 15.66\,in$	$h = 11.44\,in$
$F_y := 50\,ksi$	$F_u := 65\,ksi$	$E = 29000.0 \cdot ksi$



Check Width-Thickness Ratios

CONFIRM ALL ELEMENTS OF THIS SECTION ARE COMPACT FOR BENDING AND SHEAR AND NON-NONSLENDER FOR COMPRESSION, USING AISC TABLE B4.1 OR AS NOTED:

$\lambda_{flange} = 2.75$

$\lambda_{web} = 6.08$

AISC Case 1　$\lambda_{p\_flange\_bend} := 0.38 \cdot \sqrt{E \div F_y} = 9.15$　　$is(\lambda_{flange} \le \lambda_{p\_flange\_bend}) =$ "Yes, OK"

AISC Case 3　$\lambda_{r\_flange\_compr} := 0.56 \cdot \sqrt{E \div F_y} = 13.49$　　$is(\lambda_{flange} \le \lambda_{r\_flange\_compr}) =$ "Yes, OK"

AISC Case 9　$\lambda_{p\_web\_bend} := 3.76 \cdot \sqrt{E \div F_y} = 90.55$　　$is(\lambda_{web} \le \lambda_{p\_web\_bend}) =$ "Yes, OK"

AISC Case 10　$\lambda_{r\_web\_compr} := 1.49 \cdot \sqrt{E \div F_y} = 35.88$　　$is(\lambda_{web} \le \lambda_{r\_web\_compr}) =$ "Yes, OK"

AISC G2.1a　$\lambda_{web\_shear\_yield} := 2.24 \cdot \sqrt{E \div F_y} = 53.95$　　$is(\lambda_{web} \le \lambda_{web\_shear\_yield}) =$ "Yes, OK"

MEMBER = "Cross Beam" SHAPE = "W14X426" LOADCASE = "MAX DEVELOPED"

Cross Beam Internal Loads

$Span := 10ft = 120.0in$

$L_{CB} := 19ft + 1in$;length of cross beam

$Wt_{CB} := 9kip$;weight allowance for cross beam

$w_{CB} := \frac{Wt_{CB}}{L_{CB}} = 472 \cdot \frac{lbf}{ft}$;allowance of dist load for cross beam

$Kettle_{WT\_max} = 304.0kip$

$Rigging_{WT} = 12.0kip$

$Wt_{HB} = 36.0kip$

$a := 37.0625in$ $L_{span} := 120in$

$I = 110.0 \cdot \%$ $H_{transv} = 5.0 \cdot \%$ $H_{long} = 10.0 \cdot \%$

$$P_y := \frac{\left(Kettle_{WT\_max} + Rigging_{WT}\right) \cdot I}{2} \cdot \left(\frac{384}{510}\right) + \frac{Wt_{HB}}{2} = 148.9 \cdot kip$$

$$V_{ay} := P_y + \frac{Wt_{CB}}{2} = 153.4 \cdot kip$$

$$M_{az} := V_{ay} \cdot a + \frac{w_{CB} \cdot Span^2}{8} = 5754.7 \cdot kip \cdot in$$

$$P_{ax} := \left(\frac{Kettle_{WT\_max} + Rigging_{WT}}{2}\right) \cdot \left(\frac{384}{510}\right) \cdot H_{long} = 11.9 \cdot kip$$

$$T_{ax} := 0kip \cdot in$$

$$V_{az} := \left(\frac{Kettle_{WT\_max} + Rigging_{WT}}{2}\right) \cdot \left(\frac{384}{510}\right) \cdot H_{transv} = 5.9 \cdot kip$$

$$M_{ay} := V_{az} \cdot a = 220.5 \cdot kip \cdot in$$

MEMBER = "Cross Beam"   SHAPE = "W14X426"   LOADCASE = "MAX DEVELOPED"

Beam-Column Geometry

Stiffener := "no"   Bracing := "no"

$L_{span} = 120.0\,in$ $L_b := L_{span} = 120.0\,in$;Lb of span if stiffeners, or Lb of bracing if provided

$$L_{span} + \frac{d}{6}\cdot\left(\frac{t_f}{t_w}\right)^3 = 133.2\,in$$

$$L_b := \begin{cases} L_b & \text{if Stiffener = "yes"} \vee \text{Bracing = "yes"} \\ \left[L_{span} + \frac{d}{6}\cdot\left(\frac{t_f}{t_w}\right)^3\right] & \text{if Stiffener = "no"} \wedge \text{Bracing = "no"} \wedge \frac{d}{t_w} < 100 \wedge \frac{b_f}{d} < 1 \\ \text{"NG"} & \text{otherwise} \end{cases} = 133.2\,in$$

$L_b = 133.2\,in$ $C_b := 1$

$L_y := L_b = 133.2\,in$ $K_y := 1$

$L_z := L_b = 133.2\,in$ $K_z := 1$

$L_w := L_b = 133.2\,in$

Compression Design Strength (Pnx_Ω) - AISC E3

Slenderness Ratios

$K_y = 1.0$ $L_y = 133.2\,in$ $K_z = 1.0$ $L_z = 133.2\,in$

$\Psi_y := \frac{K_y \cdot L_y}{r_y} = 30.7$ $\Psi_z := \frac{K_z \cdot L_z}{r_z} = 18.3$ $\Psi := \max(\Psi_z, \Psi_y) = 30.7$

$$\Psi_r := 4.71\cdot\sqrt{\frac{E}{F_y}} = 113.4$$

Strength

$\Omega_c := 1.67$

$F_e := \frac{\pi^2 \cdot E}{\Psi^2} = 304.0\cdot ksi$

$$F_{cr} := \begin{cases} \left(0.658^{\frac{F_y}{F_e}}\right)\cdot F_y & \text{if } \Psi \le \Psi_r \\ 0.877\cdot F_e & \text{otherwise} \end{cases} = 46.7\cdot ksi$$

$A_g = 125.0\cdot in^2$

$$\boxed{P_{nx\_\Omega} := \frac{F_{cr}\cdot A_g}{\Omega_c} = 3494\,kip}$$

MEMBER = "Cross Beam" SHAPE = "W14X426" LOADCASE = "MAX DEVELOPED"

Shear Strength Web (Vny_Ω) - AISC CHAPTER G

$E = 29000.0 \cdot ksi$ $F_y = 50.0 \cdot ksi$

$h = 11.4in$ $t_w = 1.9in$

$\lambda_{web} = 6.1$ $A_{vy} = 35.2 \cdot in^2$

transverse_stiffeners := "no" ;either "no" or "yes"

$a := 1in$;transverse stiffener spacing

$$k_v := \left| \begin{array}{l} k_v \leftarrow 5 \ \text{ if } \ \text{transverse\_stiffeners} = \text{"no"} \wedge \lambda_{web} < 260 \\ k_v \leftarrow 5 + \dfrac{5}{\left(\dfrac{a}{h}\right)^2} \ \text{ if } \ \text{transverse\_stiffeners} = \text{"yes"} \\ k_v \leftarrow 5 \ \text{ if } \ \text{transverse\_stiffeners} = \text{"yes"} \wedge \left[\dfrac{a}{h} > 3.0 \vee \dfrac{a}{h} > \left[\dfrac{260}{\left(\dfrac{h}{t_w}\right)}\right]^2\right] \\ k_v \leftarrow \text{"Web too Slender, Redesign"} \ \text{ if } \ \lambda_{web} \ge 260 \\ \text{return } k_v \end{array} \right. = 5.0$$

$$C_{vy} := \left| \begin{array}{l} C_v \leftarrow 1.0 \ \text{ if } \ \lambda_{web} \le 2.24 \cdot \sqrt{\dfrac{E}{F_y}} \\ C_v \leftarrow 1.0 \ \text{ if } \ \lambda_{web} \le 1.10 \cdot \sqrt{\dfrac{k_v \cdot E}{F_y}} \\ C_v \leftarrow \dfrac{1.10 \cdot \sqrt{\dfrac{k_v \cdot E}{F_y}}}{\lambda_{web}} \ \text{ if } \ 1.10 \cdot \sqrt{\dfrac{k_v \cdot E}{F_y}} < \lambda_{web} \le 1.37 \cdot \sqrt{\dfrac{k_v \cdot E}{F_y}} \\ C_v \leftarrow \dfrac{1.51 \cdot E \cdot k_v}{\lambda_{web}^2 \cdot F_y} \ \text{ if } \ \lambda_{web} > 1.37 \cdot \sqrt{\dfrac{k_v \cdot E}{F_y}} \\ \text{return } C_v \end{array} \right. = 1.0$$

$V_{ny} := 0.6 \cdot F_y \cdot A_{vy} \cdot C_{vy} = 1054.7kip$

Strength

$$\Omega_v := \left| \begin{array}{l} \Omega_v \leftarrow 1.50 \ \text{ if } \ \lambda_{web} \le 2.24 \cdot \sqrt{\dfrac{E}{F_y}} \\ \Omega_v \leftarrow 1.67 \ \text{ if } \ \lambda_{web} > 2.24 \cdot \sqrt{\dfrac{E}{F_y}} \end{array} \right. = 1.5$$

$$\boxed{V_{ny\_\Omega} := \frac{V_{ny}}{\Omega_v} = 703 \cdot kip}$$

MEMBER = "Cross Beam"   SHAPE = "W14X426"   LOADCASE = "MAX DEVELOPED"

Shear Strength - Flanges (Vnz_Ω) - AISC SECTION G7

$\Omega_{vz} := 1.67$ $A_{vz} = 101.5 \cdot in^2$ $F_y = 50.0 \cdot ksi$

$C_{vz} := 1.0$

$V_{nz} := (0.6 \cdot F_y) \cdot A_{vz} \cdot C_{vz} = 3046 kip$

$$\boxed{V_{nz\_\Omega} := \frac{V_{nz}}{\Omega_{vz}} = 1824 \cdot kip}$$

Bending Strength - Strong Axis (Mnz_Ω) - AISC F2

Span Geometry

$L_b = 133.2 in$ $C_b = 1.00$ $L_b = 11.1 \cdot ft$

Limiting Lengths

$L_p := 1.76 \cdot \sqrt{\frac{E}{F_y}} \cdot r_y = 184.0 in$ $c := 1.0$ $L_p = 15.3 \cdot ft$

$$L_r := 1.95 \cdot r_{ts} \cdot \frac{E}{0.7 \cdot F_y} \cdot \sqrt{\frac{J_x \cdot c}{S_z \cdot h_0}} \cdot \sqrt{1 + \sqrt{1 + 6.76 \cdot \left(\frac{0.7 \cdot F_y}{E} \cdot \frac{S_z \cdot h_0}{J_x \cdot c}\right)^2}} = 2023 \cdot in$$

$L_r = 168.6 \cdot ft$

Strength

$\Omega_b := 1.67$

$M_{pz} := F_y \cdot Z_z = 43450 \cdot kip \cdot in$

$M_{rz} := 0.7 F_y \cdot S_z = 24710 \cdot kip \cdot in$

$$M_{nz} := \begin{cases} M_{pz} & \text{if } L_b \le L_p \\ \min\left[C_b \cdot \left[M_{pz} - (M_{pz} - M_{rz}) \left(\frac{L_b - L_p}{L_r - L_p}\right)\right], M_{pz}\right] & \text{if } L_p < L_b \le L_r \\ \min\left[S_z \cdot \left[\frac{C_b \cdot \pi^2 \cdot E}{\left(\frac{L_b}{r_{ts}}\right)^2} \cdot \sqrt{1 + 0.078 \cdot \frac{J_x \cdot c}{S_z \cdot h_0} \cdot \left(\frac{L_b}{r_{ts}}\right)^2}\right], M_{pz}\right] & \text{otherwise} \end{cases} = 43450 \cdot kip \cdot in$$

$$\boxed{M_{nz\_\Omega} := \frac{M_{nz}}{\Omega_b} = 26018 \cdot kip \cdot in}$$

MEMBER = "Cross Beam" SHAPE = "W14X426" LOADCASE = "MAX DEVELOPED"

Bending Strength - Weak Axis (Mny_Ω) - AISC F6

;take weak bending into 1 flange

$t_f = 3.04 in$ $b_f = 16.70 in$ $S_{flange} := \frac{t_f \cdot b_f^2}{6} = 141.3 \cdot in^3$ $Z_{flange} := \frac{t_f \cdot b_f^2}{4} = 212.0 \cdot in^3$

$M_{p\_flange} := F_y \cdot Z_{flange} = 10598 \cdot kip \cdot in$ $M_{y\_flange} := 1.6 F_y \cdot S_{flange} = 11304 \cdot kip \cdot in$

$M_{ny} := \min(M_{p\_flange}, M_{y\_flange}) = 10598 \cdot kip \cdot in$

$$\boxed{M_{ny\_\Omega} := \frac{M_{ny}}{\Omega_b} = 6346 \cdot kip \cdot in}$$

MEMBER = "Cross Beam" SHAPE = "W14X426" LOADCASE = "MAX DEVELOPED"

Axial Compression & Flexure Strength Ratios

$P_{nx\_\Omega} = 3493.5 \cdot kip$ $P_{ax} = 11.9 \cdot kip$ $SR_{Px} := \frac{P_{ax}}{P_{nx\_\Omega}} = 0.00$

$M_{ny\_\Omega} = 6346.0 \cdot kip \cdot in$ $M_{ay} = 220.5 \cdot kip \cdot in$ $SR_{My} := \frac{M_{ay}}{M_{ny\_\Omega}} = 0.03$

$M_{nz\_\Omega} = 26018.0 \cdot kip \cdot in$ $M_{az} = 5754.7 \cdot kip \cdot in$ $SR_{Mz} := \frac{M_{az}}{M_{nz\_\Omega}} = 0.22$

Shear Strength Ratios

$V_{ny\_\Omega} = 703.1\,kip$ $V_{ay} = 153.4\,kip$ $SR_{Vy} := \frac{V_{ay}}{V_{ny\_\Omega}} = 0.22$

$V_{nz\_\Omega} = 1824.0\,kip$ $V_{az} = 5.9\,kip$ $SR_{Vz} := \frac{V_{az}}{V_{nz\_\Omega}} = 0.00$

MEMBER = "Cross Beam" SHAPE = "W14X426" LOADCASE = "MAX DEVELOPED"

Axial Compression + Flexure Interation Ratio (AISC H1)

$$IR_{H1\_1} := \begin{cases} \dfrac{P_{ax}}{P_{nx\_\Omega}} + \dfrac{8}{9}\cdot\left(\dfrac{M_{ay}}{M_{ny\_\Omega}} + \dfrac{M_{az}}{M_{nz\_\Omega}}\right) & \text{if } \max\left(\dfrac{P_{ax}}{P_{nx\_\Omega}}\right) \ge 0.2 \\ \dfrac{1}{2}\dfrac{P_{ax}}{P_{nx\_\Omega}} + \left(\dfrac{M_{ay}}{M_{ny\_\Omega}} + \dfrac{M_{az}}{M_{nz\_\Omega}}\right) & \text{otherwise} \end{cases} = 0.26$$

$$\boxed{is\left(\max\left(IR_{H1\_1}\right) \le 1.0\right) = \text{"Yes, OK"}}$$

$$\frac{P_{ax}}{P_{nx\_\Omega}} + \frac{8}{9}\cdot\left(\frac{M_{ay}}{M_{ny\_\Omega}} + \frac{M_{az}}{M_{nz\_\Omega}}\right) = 0.23$$

;for reference

$$\frac{1}{2}\frac{P_{ax}}{P_{nx\_\Omega}} + \left(\frac{M_{ay}}{M_{ny\_\Omega}} + \frac{M_{az}}{M_{nz\_\Omega}}\right) = 0.26$$

Deflection - Center Span

$L := L_{span} = 120.0\,in$ $I_z = 6600.0\cdot in^4$ $E = 29000.0\cdot ksi$ $Kettle_{WT\_max} = 304.0\,kip$ $Wt_{HB} = 36.0\,kip$

$a := 37.0625\,in$ $Rigging_{WT} = 12.0\,kip$

$w_{CB} = 471.6\cdot\frac{lbf}{ft}$

$$P := \frac{Kettle_{WT\_max} + Rigging_{WT}}{2}\cdot\left(\frac{384}{510}\right) + \frac{Wt_{HB}}{2} = 137.0\cdot kip$$

$$\delta_{\_y} := \frac{P\cdot a}{24\cdot E\cdot I_z}\cdot\left(3\cdot L^2 - 4\cdot a^2\right) + \frac{5\cdot w_{CB}\cdot L^4}{384\cdot E\cdot I_z} = 0.04\,in$$

$$\frac{L}{\delta_{\_y}} = 2842.1$$

$$\boxed{is\left(\frac{L}{\delta_{\_y}} > 480\right) = \text{"Yes, OK"}}$$

MEMBER = "Cross Beam" SHAPE = "W14X426" LOADCASE = "MAX DEVELOPED"

Concentrated Load Checks - End Reactions

cf_restrain := "no" ;if the compression flange is restained against rotation - "yes"
if the compression flange is not restrained against rotation - "no"

stiff_R := "no" ;if bearing stiffeners provided - "yes"
if bearing stiffeners not provided - "no"

$d = 18.70\,in$ $t_w = 1.88\,in$ $t_f = 3.04\,in$ $k_{des} = 3.63\,in$ $F_y = 50.0\cdot ksi$ $F_u = 65.0\cdot ksi$ $E = 29000.00\cdot ksi$

$$L_{Load} := \frac{L_{CB} - L_{span}}{2} = 54.5\,in$$;distance of load from the end of the member

$N := 0\,in$;length of bearing (conservative)

$V_{ay} = 153.4\,kip$ $R_{max} := \max(V_{ay}) = 153.4\,kip$;max reaction at leg

Web Local Yielding (AISC J10.2)

$\Omega_{J10.2} := 1.50$ $k_{des} = 3.63\,in$ $N = 0.0$ $F_y = 50.0\cdot ksi$ $t_w = 1.88\,in$ $L_{Load} = 54.50\,in$ $d = 18.70\,in$

$$R_{n\_J10.2} := \begin{cases} \left[(5\cdot k_{des} + N)\cdot F_y\cdot t_w\right] & \text{if } L_{Load} > d \\ \left[(2.5\cdot k_{des} + N)\cdot F_y\cdot t_w\right] & \text{otherwise} \end{cases} = 1706.1\,kip$$

$$R_{n\_J10.2\_\Omega} := \frac{R_{n\_J10.2}}{\Omega_{J10.2}} = 1137.4\,kip$$

$$\boxed{\frac{R_{max}}{R_{n\_J10.2\_\Omega}} = 0.13}$$

Web Crippling (AISC J10.3)

$\Omega_{J10.3} := 2.00$ $t_w = 1.88\,in$ $N = 0.0$ $d = 18.70\,in$ $t_f = 3.04\,in$ $E = 29000.0\cdot ksi$ $F_y = 50.0\cdot ksi$ $L_{Load} = 54.50\,in$

$$R_{n\_J10.3} := \begin{cases} \left[0.80\cdot t_w^2\cdot\left[1 + 3\cdot\left(\frac{N}{d}\right)\cdot\left(\frac{t_w}{t_f}\right)^{1.5}\right]\cdot\sqrt{\frac{E\cdot F_y\cdot t_f}{t_w}}\right] & \text{if } L_{Load} \ge \frac{d}{2} \\ \text{otherwise} & \\ \quad \begin{cases} 0.40\cdot t_w^2\cdot\left[1 + 3\cdot\left(\frac{N}{d}\right)\cdot\left(\frac{t_w}{t_f}\right)^{1.5}\right]\cdot\sqrt{\frac{E\cdot F_y\cdot t_f}{t_w}} & \text{if } \frac{N}{d} \le 0.2 \\ 0.40\cdot t_w^2\cdot\left[1 + \left(\frac{4N}{d} - 0.2\right)\cdot\left(\frac{t_w}{t_f}\right)^{1.5}\right]\cdot\sqrt{\frac{E\cdot F_y\cdot t_f}{t_w}} & \text{if } \frac{N}{d} > 0.2 \end{cases} \end{cases} = 4329.6\,kip$$

$$R_{n\_J10.3\_\Omega} := \frac{R_{n\_J10.3}}{\Omega_{J10.3}} = 2164.8\,kip$$

$$\boxed{\frac{R_{max}}{R_{n\_J10.3\_\Omega}} = 0.07}$$

MEMBER = "Cross Beam" SHAPE = "W14X426" LOADCASE = "MAX DEVELOPED"

Web Sidesway Buckling (AISC J10.4)

$\Omega_{J10.4} := 1.76$ $t_w = 1.88 in$ $N = 0.0$ $d = 18.70 in$ $t_f = 3.04 in$ $E = 29000.0 \cdot ksi$ $F_y = 50.0 \cdot ksi$ $L_{Load} = 54.50 in$

$h = 11.4 in$ $l := L_b = 133.2 in$

cf_restrain = "no" ;if the compression flange is restained against rotation - "yes"
if the compression flange is not restrained against rotation - "no"

stiff_R = "no" ;if bearing stiffeners provided - "yes"
if bearing stiffeners not provided - "no"

$M_{az} = 5754.7 \cdot kip \cdot in$ $M_z := \max(M_{az}) = 5754.7 \cdot kip \cdot in$ $M_y := S_z \cdot F_y = 35300.0 \cdot kip \cdot in$

$$C_r := \begin{cases} 960000ksi & \text{if } 1.5 \cdot M_z < M_y \\ 480000ksi & \text{if } 1.5 \cdot M_z \geq M_y \end{cases} = 960000.0 \cdot ksi$$

$$\left(\frac{h}{t_w}\right) \div \left(\frac{l}{b_f}\right) = 0.76$$;for reference

$$R_{n\_J10.4} := \begin{cases} \text{if cf\_restrain} = \text{"yes"} & \begin{cases} \dfrac{C_r \cdot t_w^3 \cdot t_f}{h^2} \cdot \left[1 + 0.4 \cdot \left(\dfrac{\frac{h}{t_w}}{\frac{l}{b_f}}\right)^3\right] & \text{if } \left(\dfrac{h}{t_w}\right) \div \left(\dfrac{l}{b_f}\right) \leq 2.3 \\ \text{"J10.4 does not apply"} & \text{if } \left(\dfrac{h}{t_w}\right) \div \left(\dfrac{l}{b_f}\right) > 2.3 \end{cases} \\ \text{if cf\_restrain} = \text{"no"} & \begin{cases} \dfrac{C_r \cdot t_w^3 \cdot t_f}{h^2} \cdot \left[0.4 \cdot \left(\dfrac{\frac{h}{t_w}}{\frac{l}{b_f}}\right)^3\right] & \text{if } \left(\dfrac{h}{t_w}\right) \div \left(\dfrac{l}{b_f}\right) \leq 1.7 \\ \text{"J10.4 does not apply"} & \text{if } \left(\dfrac{h}{t_w}\right) \div \left(\dfrac{l}{b_f}\right) > 1.7 \end{cases} \end{cases} = 26332.2 kip$$

$$R_{n\_J10.4\_\Omega} := \frac{R_{n\_J10.4}}{\Omega_{J10.4}} = 14961.4 kip$$

$$\boxed{\frac{R_{max}}{R_{n\_J10.4\_\Omega}} = 0.01}$$

SUMMARY = "All applicable concentrated load checks OK without stiffeners"

4. Gantry Analysis - 700T Gantry System (HG700 (J&R 1400 Series))

Gantry Leg Capacity Check

$Kettle_{WT\_max} = 304.0\,kip$;from before

$Rigging_{WT} = 12.0\,kip$ $Wt_{HB} = 36.0\cdot kip$ $Wt_{CB} = 9.0\,kip$;allowances

$$P_g := \frac{Wt_{HB} + Wt_{CB}}{2} + \frac{Kettle_{WT\_max} + Rigging_{WT}}{2}\cdot\left(\frac{384}{510}\right) = 141.5\,kip$$

$P_g = 141.5\cdot kip$;gantry max unfactored vertical load at top of gantry leg.

$Gantry_{scope} := 30.58ft = 367.0\,in$;maximum anticipated leg scope during operation

;for use of gantry as shown on DWG 001 sheet 3, 2nd stage without manual extended

$$Gantry_{capacity} := \begin{cases} \dfrac{700tonf}{4} & \text{if } 13.83ft \le Gantry_{scope} \le 22.42ft \\ \dfrac{470tonf}{4} & \text{if } 22.42ft < Gantry_{scope} \le 30.58ft \\ \text{"Outside of Gantry Scope Range"} & \text{otherwise} \end{cases} = 235.0\cdot kip$$

$$\boxed{\frac{P_g}{Gantry_{capacity}} = 0.60}$$

Gantry Tower Stability (as presented by "Rigging with Gantries" David Duerr 1994)

Parameters: Overall gantry and geometry and variable definitions.

Loads

$P_g = 141.5\cdot kip$;Applied Vertical Load (service load) to top of gantry leg (see above)

$W_g := 22.3\cdot kip$;gantry single leg dead load

$F_{lat} := H_{transv}\cdot P_g = 7.1\cdot kip$;Lateral Load to gantry leg

$F_{long} := H_{long}\cdot P_g = 14.1\cdot kip$;Longitudinal load to gantry leg

Geometry

$Gantry_{scope} = 30.6\cdot ft$ $d_{beams} := 45in$

$H_g := Gantry_{scope} + d_{beams} = 412.0\cdot in$;Gantry leg extension, use max leg scope + depth of header/cross beams

$h_{cg} := 40\%\cdot Gantry_{scope} = 146.78\cdot in$;Assumed leg CG value at 40% extended height

$T_g := 46.625in = 46.625in$;Track width of jacking unit outside wheel to wheel

$G_g := 36in$;Track Beam Spacing (gage)

$WB_g := 87.5in$;Wheelbase wheel to weel longitudinal

$\Delta := \frac{1in}{120in}\cdot\left(Gantry_{scope} - 13.83ft\right) = 1.67in$;Predicted displacement of top of gantry leg due to boom clearances: ~1" for 10ft extension. This is an assumption to accomodate for additional out of plumbness due to lateral loads.

Runway Track Data

$Percent_{lat} := \dfrac{\frac{1}{8}in}{36in} = 0.347 \cdot \%$;Track lateral slope
Accounts for levelness

$\theta_{lat} := atan(Percent_{lat}) = 0.199 \cdot deg$;Runway track rotation (lateral)

$Percent_{long} := \dfrac{\frac{1}{2}in}{120in} = 0.417 \cdot \%$;Track longitudinal slope
Accounts for levelness

$\theta_{long} := atan(Percent_{long}) = 0.239 \cdot deg$;Runway track rotation (longitudinal)

Analysis

$H_{v\_lat} := H_g \cdot cos(\theta_{lat}) = 412.0 \cdot in$;Vertical projection of gantry extended height 'H' for lateral slope

$H_{v\_long} := H_g \cdot cos(\theta_{long}) = 412.0 \cdot in$;Vertical projection of gantry extended height 'H' for longitudinal slope

$T_h := T_g \cdot cos(\theta_{lat}) = 46.62 \cdot in$;Horizontal projection of track width of Jack Unit for lateral slope

$T_v := T_g \cdot sin(\theta_{lat}) = 0.162 \cdot in$;Difference in elevation of track beams from lateral slope.

$WB_h := WB_g \cdot cos(\theta_{long}) = 87.50 in$;Wheelbase horizontal projection for longitudinal slope

$WB_v := WB_g \cdot sin(\theta_{long}) = 0.365 in$;Wheelbase difference in elevation from longitudinal slope

$\delta_{latll} := H_g \cdot sin(\theta_{lat}) = 1.430 in$;Lateral displacement of boom top due to lateral slope

$\delta_{latdl} := h_{cg} \cdot sin(\theta_{lat}) = 0.510 in$;Lateral displacement of CG due to lateral slope

$\delta_{longll} := H_g \cdot sin(\theta_{long}) = 1.716 in$;Longitudinal displacement of boom top due to longitudinal slope

$\delta_{longdl} := h_{cg} \cdot sin(\theta_{long}) = 0.612 in$;Longitudinal displacement of CG due to due to longitudinal slope

Stability Results:

Lift_Type = "dynamic"

Safety Factor against Tipping: Lateral direction

$MR_{lat} := P_g \cdot \left(\dfrac{T_h}{2} - \delta_{latll} - \Delta\right) + W_g \cdot \left(\dfrac{T_h}{2} - \delta_{latdl}\right) = 3367.1 \cdot kip \cdot in$;Righting Moment

$MO_{lat} := H_{v\_lat} \cdot F_{lat} = 2913.9 \cdot kip \cdot in$;Overturning Moment

$OverturnSF_{lat} := \dfrac{MR_{lat}}{MO_{lat}} = 1.16$ $\boxed{is(OverturnSF_{lat} \geq 1.1) = \text{"Yes, OK"}}$;conservative lateral loading, maintain greater than 1.1 minimum

Safety Factor against Tipping: Longitudinal direction

$$MR_{long} := P_g \cdot \left(\frac{WB_h}{2} - \delta_{longll} - \Delta\right) + W_g \cdot \left(\frac{WB_h}{2} - \delta_{longdl}\right) = 6671.2 \cdot kip \cdot in$$

;Righting Moment

$$MO_{long} := H_{v\_long} \cdot F_{long} = 5827.7 \cdot kip \cdot in$$

;Overturning Moment

$$OverturnSF_{long} := \frac{MR_{long}}{MO_{long}} = 1.14$$

$$\boxed{is\left(OverturnSF_{long} \geq 1.1\right) = \text{"Yes, OK"}}$$

;conservative lateral loading, maintain greater than 1.1 minimum

5. TRACK AND CRIBBING ANALYSIS

Conservative check assuming toe and heel point loads (due to deflection, actual is distributed).

Impact factors

$E := 29000ksi$ $I = 110.0 \cdot \%$ $H_{long} = 10.0 \cdot \%$ $H_{transv} = 5.0 \cdot \%$

$W_g = 22.30kip$ $P_g = 141.5kip$

$Wg_{bj} := W_g + P_g = 163.8 \cdot kip$;Net load at base of jacks

$H_g = 412.0 \cdot in$;Maximum gantry ht during lift (scope + depth of beams)

$WB_g = 87.5in$;Gantry wheelbase

$G_g = 36.0in$;Gantry wheel gauge

$s_{supp} := 30in = 30.0in$;Max. support spacing

$w_{tr} := 280plf = 0.02333 \cdot \frac{kip}{in}$;Track weight

$W_{tr} := s_{supp} \cdot w_{tr} = 0.700 \cdot kip$;Net track weight per span

Gantry Corner Loads

$Pg_{whl} := \frac{W_g + P_g}{4} = 40.9 \cdot kip$;Basic corner load (LL + DL)

$Pg_{1y} := \frac{I \cdot (P_g)}{4} + \frac{W_g}{4} = 44.5 \cdot kip$;Load combination 1. (I*LL + DL)

$Pg_{2y\_max} := Pg_{1y} + \frac{(H_{transv} \cdot P_g) \cdot H_g}{2 \cdot G_g} = 84.9 \cdot kip$;Load combination 2 max. (I*LL + DL + Htransv*LL)

$Pg_{2y\_min} := Pg_{1y} - \frac{(H_{transv} \cdot P_g) \cdot H_g}{2 \cdot G_g} = 4.0 \cdot kip$;Load combination 2 min. (I*LL + DL - Htransv*LL)

$Pg_{3y\_max} := Pg_{1y} + \frac{(H_{long} \cdot P_g) \cdot H_g}{2 \cdot WB_g} = 77.8 \cdot kip$;Load combination 3 max. (I*LL + DL + Hlong*LL)

$Pg_{3y\_min} := Pg_{1y} - \frac{(H_{long} \cdot P_g) \cdot H_g}{2 \cdot WB_g} = 11.2 \cdot kip$;Load combination 3 min. (I*LL + DL - Hlong*LL)

$Pg_{max} := \max(Pg_{1y}, Pg_{2y\_max}, Pg_{3y\_max}) = 84.9 \cdot kip$;Max gantry corner load from all load combinations

Section properties

$b_{f\_track} := 12in$ $t_f := 0.75in$ $F_y := 36ksi$ $d := 15.5in$

$h_w := 14in$ $t_w := 0.375in$ $S_z := 148.6in^3$

$y_{na} := 7.75in$ $y_p := y_{na}$ $Z_z := 169.5in^3$ $I_z := 1151.4in^4$

$A_w := 2h_w \cdot t_w = 10.5 \cdot in^2$

Check Width-Thickness Ratios

Flange Compactness

$$\lambda_f := \frac{b_{f\_track}}{t_f} = 16.0$$

$$Flange := if\left(\lambda_f > 1.12\cdot\sqrt{\frac{E}{F_y}}, if\left(\lambda_f > 1.4\sqrt{\frac{E}{F_y}}, \text{"Slender"}, \text{"Noncompact"}\right), \text{"Compact"}\right) = \text{"Compact"}$$

Web Compactness

$$\lambda_w := \frac{h_w}{t_w} = 37.3$$

$$Web := if\left(\lambda_w > 2.42\cdot\sqrt{\frac{E}{F_y}}, if\left(\lambda_w > 5.7\sqrt{\frac{E}{F_y}}, \text{"Slender"}, \text{"Noncompact"}\right), \text{"Compact"}\right) = \text{"Compact"}$$

Bending Strength - Strong Axis (Mnz_Ω) - AISC F7

Bending Case: Single wheel at midspan

$$M1_g := \frac{Pg_{max}\cdot s_{supp}}{4} + w_{tr}\cdot\frac{s_{supp}^{\ 2}}{8} = 639.7\cdot kip\cdot in$$;Bending moment

Bending Case: Two wheel moving load

$$x := if\left[WB_g < 0.586\cdot s_{supp}, 0.5\cdot\left(s_{supp} - \frac{WB_g}{2}\right), \frac{s_{supp}}{2}\right] = 15.0\cdot in$$;Load location

$$M2_g := if\left[WB_g < 0.586\cdot s_{supp}, \frac{Pg_{max}}{2\cdot s_{supp}}\cdot\left(s_{supp} - \frac{WB_g}{2}\right)^2, \frac{Pg_{max}\cdot s_{supp}}{4}\right] = 637.1\cdot kip\cdot in$$

$$M_{max} := max\left(M1_g, if\left(x > s_{supp} - WB_g, 0, M2_g\right)\right) = 639.7\cdot kip\cdot in$$

Strength

$\Omega_b := 1.67$;Bending safety factor

$$M_{nz\_\Omega} := \frac{F_y\cdot Z_z}{\Omega_b} = 3653.9\cdot kip\cdot in \qquad \boxed{\frac{M_{max}}{M_{nz\_\Omega}} = 0.18}$$;Allowable Flexural Strength

Shear Strength - Webs (Vny_Ω) - AISC G

$$V_{max} := if\left[WB_g > s_{supp}, Pg_{max}, Pg_{max}\cdot\left(2 - \frac{WB_g}{s_{supp}}\right)\right] + W_{tr} = 85.6\cdot kip$$

Allowable Shear

$k_v := 5$;Web plate buckling coefficient

$$C_v := if\left(\lambda_w > 1.1\cdot\sqrt{\frac{k_v\cdot E}{F_y}}, if\left(\lambda_w > 1.37\sqrt{\frac{k_v\cdot E}{F_y}}, \frac{1.51\cdot E\cdot k_v}{\lambda_w^{\ 2}\cdot F_y}, \frac{1.1\cdot\sqrt{\frac{k_v\cdot E}{F_y}}}{\lambda_w}\right), 1\right) = 1.0$$

$V_n := 0.6 \cdot F_y \cdot A_w \cdot C_v = 226.8 \cdot kip$;Nominal shear strength

$\Omega_v := 1.67$;Shear safety factor

$V_{ny\_\Omega} := \dfrac{V_n}{\Omega_v} = 135.8 \cdot kip$ $\boxed{\dfrac{V_{max}}{V_{ny\_\Omega}} = 0.63}$;Allowable shear strength

Deflection check

Gantry Track Analysis

$Pg_{max} = 84.9 \cdot kip$ $s_{supp} = 30.0 in$ $E = 29000.0 \cdot ksi$ $I_z = 1151.4 \cdot in^4$ $w_{tr} = 0.02333 \cdot \dfrac{kip}{in}$

$\delta_{estimate} := \dfrac{Pg_{max} \cdot s_{supp}{}^3}{48 \cdot E \cdot I_z} + \dfrac{5 w_{tr} \cdot s_{supp}{}^4}{384 \cdot E \cdot I_z} = 0.00144 in$ $\dfrac{s_{supp}}{\delta_{estimate}} = 20856.3$ $\boxed{is\left(\dfrac{s_{supp}}{\delta_{estimate}} > 960\right) = \text{"Yes, OK"}}$

Local Force Check (per web)

Concentrated Load Checks - End Reactions

cf_restrain := "yes" ;if the compression flange is restained against rotation - "yes"
if the compression flange is not restrained against rotation - "no"

stiff_R := "no" ;if bearing stiffeners provided - "yes"
if bearing stiffeners not provided - "no"

$d = 15.50 in$ $t_w = 0.38 in$ $t_f = 0.75 in$ $k_{des} := t_f \cdot 1.5 = 1.13 in$ $F_y = 36.0 \cdot ksi$ $F_u = 65.0 \cdot ksi$ $E = 29000.00 \cdot ksi$

$L_{Load} := 24 in$;distance of load from the end of the member

$N := 0 in$;length of bearing (conservative)

$V_{max} = 85.6 \cdot kip$ $R_{max} := \dfrac{V_{max}}{2} = 42.8 \cdot kip$;max reaction wheel (2-wheels per corner reaction)

Web Local Yielding (AISC J10.2)

$\Omega_{J10.2} := 1.50$ $k_{des} = 1.13 in$ $N = 0.0$ $F_y = 36.0 \cdot ksi$ $t_w = 0.38 in$ $L_{Load} = 24.00 in$ $d = 15.50 in$

$$R_{n\_J10.2} := \begin{cases} \left[\left(5 \cdot k_{des} + N\right) \cdot F_y \cdot t_w\right] & \text{if } L_{Load} > d \\ \left[\left(2.5 \cdot k_{des} + N\right) \cdot F_y \cdot t_w\right] & \text{otherwise} \end{cases} = 75.9 \cdot kip$$

$R_{n\_J10.2\_\Omega} := \dfrac{R_{n\_J10.2}}{\Omega_{J10.2}} = 50.6 \cdot kip$ $\boxed{\dfrac{R_{max}}{R_{n\_J10.2\_\Omega}} = 0.85}$

Web Crippling (AISC J10.3)

$\Omega_{J10.3} := 2.00$ $t_w = 0.38 in$ $N = 0.0$ $d = 15.50 in$ $t_f = 0.75 in$ $E = 29000.0 \cdot ksi$ $F_y = 36.0 \cdot ksi$ $L_{Load} = 24.00 in$

$$R_{n\_J10.3} := \begin{cases} \left[0.80 \cdot t_w^2 \cdot \left[1 + 3 \cdot \left(\frac{N}{d}\right) \cdot \left(\frac{t_w}{t_f}\right)^{1.5}\right] \cdot \sqrt{\frac{E \cdot F_y \cdot t_f}{t_w}}\right] & \text{if } L_{Load} \geq \frac{d}{2} \\ \text{otherwise} & \\ \quad \begin{cases} 0.40 \cdot t_w^2 \cdot \left[1 + 3 \cdot \left(\frac{N}{d}\right) \cdot \left(\frac{t_w}{t_f}\right)^{1.5}\right] \cdot \sqrt{\frac{E \cdot F_y \cdot t_f}{t_w}} & \text{if } \frac{N}{d} \leq 0.2 \\ 0.40 \cdot t_w^2 \cdot \left[1 + \left(\frac{4N}{d} - 0.2\right) \cdot \left(\frac{t_w}{t_f}\right)^{1.5}\right] \cdot \sqrt{\frac{E \cdot F_y \cdot t_f}{t_w}} & \text{if } \frac{N}{d} > 0.2 \end{cases} \end{cases} = 162.6 \cdot kip$$

$$R_{n\_J10.3\_\Omega} := \frac{R_{n\_J10.3}}{\Omega_{J10.3}} = 81.3 \cdot kip$$

$$\boxed{\frac{R_{max}}{R_{n\_J10.3\_\Omega}} = 0.53}$$

Web Sidesway Buckling (AISC J10.4)

$\Omega_{J10.4} := 1.76$ $t_w = 0.38 in$ $N = 0.0$ $d = 15.50 in$ $t_f = 0.75 in$ $E = 29000.0 \cdot ksi$ $F_y = 36.0 \cdot ksi$ $L_{Load} = 24.00 in$

$h := h_w = 14.0 in$ $l := s_{supp} = 30.0 in$ $b_f := b_{f\_track} = 12.0 in$

cf_restrain = "yes" ;if the compression flange is restained against rotation - "yes"
if the compression flange is not restrained against rotation - "no"

stiff_R = "no" ;if bearing stiffeners provided - "yes"
if bearing stiffeners not provided - "no"

$S_z = 148.6 \cdot in^3$ $F_y = 36.0 \cdot ksi$

$M_z = 5754.7 \cdot kip \cdot in$ $M_y := S_z \cdot F_y = 5349.6 \cdot kip \cdot in$

$$C_r := \begin{cases} 960000 ksi & \text{if } 1.5 \cdot M_z < M_y \\ 480000 ksi & \text{if } 1.5 \cdot M_z \geq M_y \end{cases} = 480000.0 \cdot ksi$$

$\left(\frac{h}{t_w}\right) \div \left(\frac{l}{b_f}\right) = 14.93$;for reference

$$R_{n\_J10.4} := \begin{cases} \text{if cf\_restrain} = \text{"yes"} & \\ \quad \begin{cases} \frac{C_r \cdot t_w^{\,3} \cdot t_f}{h^2} \cdot \left[1 + 0.4 \cdot \left(\frac{\frac{h}{t_w}}{\frac{l}{b_f}}\right)^3\right] & \text{if } \left(\frac{h}{t_w}\right) \div \left(\frac{l}{b_f}\right) \le 2.3 \\ \text{"J10.4 does not apply"} & \text{if } \left(\frac{h}{t_w}\right) \div \left(\frac{l}{b_f}\right) > 2.3 \end{cases} & \\ \text{if cf\_restrain} = \text{"no"} & \\ \quad \begin{cases} \frac{C_r \cdot t_w^{\,3} \cdot t_f}{h^2} \cdot \left[0.4 \cdot \left(\frac{\frac{h}{t_w}}{\frac{l}{b_f}}\right)^3\right] & \text{if } \left(\frac{h}{t_w}\right) \div \left(\frac{l}{b_f}\right) \le 1.7 \\ \text{"J10.4 does not apply"} & \text{if } \left(\frac{h}{t_w}\right) \div \left(\frac{l}{b_f}\right) > 1.7 \end{cases} & \end{cases} = \text{"J10.4 does not apply"}$$

$$R_{n\_J10.4\_\Omega} := \begin{cases} \frac{R_{n\_J10.4}}{\Omega_{J10.4}} & \text{if } R_{n\_J10.4} \ne \text{"J10.4 does not apply"} \\ \text{"J10.4 does not apply"} & \text{otherwise} \end{cases} = \text{"J10.4 does not apply"}$$

$$\boxed{SR := \begin{cases} \frac{R_{max}}{R_{n\_J10.4\_\Omega}} & \text{if } R_{n\_J10.4} \ne \text{"J10.4 does not apply"} \\ \text{"J10.4 does not apply"} & \text{otherwise} \end{cases} = \text{"J10.4 does not apply"}}$$

Timber & Ground Bearing Analysis (static only)

Analysis assumes that static maximum bearing pressure will be provided by customer and dynamic loading (from lateral forces) are minimal in occurance.

$w_{gt} := 280\frac{lbf}{ft}$;gantry track unit weight

$L_{gt} := 20ft$;gantry track length

$W_{gt} := L_{gt} \cdot w_{gt} = 5.6 \cdot kip$;gantry track weight

$L_{timber} := 4ft$;Length of supporting timbers

$b_{timber} := 7.5in$;Width of supporting timbers

$N_{timber\_gt} := 9$;Number of supporting timbers under a 20ft gantry track (min)

$N_{supt\_timbers} := 4$;Number of supporting timbers under gantry leg load. Timbers spaced at 30" centers. Therefore a single gantry leg contact will transer to approx. (4x) timbers at any time. Use (4) to be conservative.

$W_{6x8} := 12.5\frac{lbf}{ft} \cdot L_{timber} = 0.050\,kip$;Weight of a 6x8 timber

$W_{mat} := 3200lbf$;Weight of a 1ft x 4ft x 20ft crane mat

$R_{base} := P_g + W_g = 163.8 \cdot kip$;Reaction at base of gantry leg

Check timber bearing:

$P_{timber} := \frac{R_{base} + W_{gt}}{N_{supt\_timbers}} = 42.3 \cdot kip$;Load to a single timber

$A_{timber\_contact} := N_{supt\_timbers} \cdot b_{timber} \cdot 2 \cdot b_{f\_track} = 5.0 \cdot ft^2$;Timber top bearing area

$q_{timber} := \frac{P_{timber}}{A_{timber\_contact}} = 58.8 \cdot psi$;Timber compression perpendicular to grain

$Q_{allow\_timber} := 800psi$;Timber allowable: compression perpendicular to grain

$\boxed{\frac{q_{timber}}{Q_{allow\_timber}} = 0.07}$;Strength Ratio of crushing

Ground Bearing:

$P_{ground} := R_{base} + \left(W_{6x8} \cdot 4\right) + \frac{W_{mat}}{2} = 165.6 \cdot kip$;Load to ground over effective contact area

$L_{bearing} := [30in + (2) \cdot 3.75in + (2) \cdot 12in] \cdot 2 = 10.3 \cdot ft$ $W_{bearing} := 4ft$ $A_{bearing} := L_{bearing} \cdot W_{bearing} = 41.0 \cdot ft^2$

$\boxed{q := \frac{P_{ground}}{A_{bearing}} = 4.04 \cdot ksf}$;Ground bearing pressure capacity required by others

MAY 1980

Permit # 46212

REPORT
SOILS INVESTIGATION
WEST COAST SMELTER FACILITY
VERNON, CALIFORNIA
REQUISITION NO. 12253
CONTRACT NO. 7515

D-236

Dames & Moore
Job No. 11831-001-14
May 5, 1980

May 5, 1980
Our Ref: 11831-001-14
Contract No. M7515
Purchase Order No: M7515-3000

Dravo Corporation
Dravo Building
1250, 14th Street
Denver, Colorado 80202

Attention: Mr. Robert C. Meyer
Project Manager

Gentlemen:

Submitted with this letter are five copies of our "Report, Soils investigation, West Coast Smelter Facility, Vernon, California, Requisition No.12253, Contract No. M7515".

The scope of this investigation was planned in discussions with Messrs. Robert C. Meyer and Willie T. Grant of Dravo Corporation. Verbal recommendations regarding preliminary foundation design data were provided to Mr. Willie T. Grant during the progress of this job. Pertinent test results were also discussed with the representatives of Dravo Corporation as such data became available. Our final recommendations for the foundation design system are presented in the pertinent sections of this report.

It has been a pleasure to serve you on this project and we appreciate the cooperation extended to us for the timely completion of the project.

If you have any questions concerning this report, need additional information or require other services including EIR for environmental problems, please contact us.

Very truly yours

DAMES & MOORE

Mohammad A. Latif
Associate

Charles V. Logie
Partner

MAL:CVL:sj

5 copies submitted

TABLE OF CONTENTS

REPORT
SOILS INVESTIGATION
WEST COAST SMELTER FACILITY
VERNON, CALIFORNIA
REQUISITION NO. 75150
CONTRACT NO. M7515

INTRODUCTION

GENERAL

In this report we present the results of our soils investigation for the West Coast Smelter Facility to be located at Gould Inc., Metals Division Property in Vernon, California. The general location of the site with respect to the surrounding features is shown on Plate 1, Vicinity Map. The general area investigated and the boring locations are shown on Plate 2, Plot Plan. This investigation was performed in accordance with the terms of our proposal dated Febraury 13, 1980 and your purchase order No. M7515-3000 dated March 4, 1980.

The site is located at the northeast corner of 26th Street and Indiana Street in the city of Vernon, California.

PROPOSED CONSTRUCTION

It is our understanding that the West Coast Smelter facility will include the following structures:

1. Smelter Building

This building is 137½ feet by 215 feet in plan dimensions. This building consists of lead stacks, lead casting machine, blast furnaces, reverb slag conveyor, slag casting machine and two rows of hard lead receiving kettles. In addition, an access road is planned to the east of this building. The soil conditions for this building were investigated by drilling borings B-4, B-5 and B-8.

2. Blast furnace raw material storage

This building will be 90 feet by 125 feet in plan dimensions and will include the reverb slag storage area, loading dock, coke storage, slag cooling and breaking area and reagent storage area. The soils conditions for this storage area are represented by boring B-8.

3. Baghouse

This structure will include soft lead baghouse, hard lead baghouse, blast furnace baghouse, material storage baghouse, reverb baghouse, electrical substation, conveyor system and scrubber. The soil conditions for this area are represented by borings B-3 and B-7.

4. ABRP Plant Scrap Lime Slaker Neutralization Building

This building will be 94 feet by 80 feet in plan dimensions and will include a loading dock, control room, mud storage tanks and pH adjustment tanks. The soil conditions for this building are represented by boring B-2.

5. Reverb Material Storage

This area will be 90 feet by 150 feet in plan dimensions and will include filter coke storage up to a capacity of 47,650 cu. ft. It is understood that the density of this material will be 180 pounds per cubic foot and the storage pile will be approximately 20-foot high. In addition, battery grid storage area of up to 17,300 cu. foot capacity is planned. The density of the material in the battery grid storage area will be approximately 250 pounds per cu. foot and the pile will be approximately 20-foot high. Radial stackers are planned to transport and pile up these materials. The soil conditions for this storage area are represented by boring B-6.

6. Truck Dumper, Battery Hopper, Oscillating Conveyor, Truck Scale, Scale House and Washrack are also planned within this facility. The soil conditions for the scale house were investigated by drilling boring B-1 and those for the battery hopper area were investigated by drilling boring B-6.

7. Stack

A steel stack of 125 feet in height is proposed to be constructed within this facility. The soil conditions in this area are represented by boring B-7.

It is our further understanding that the estimated loads for major strucures will be as follows:

1. Process and Storage Buildings
   Elevated floor slab (maximum load) = 3 ksf to 4 ksf
   Floor slab on grade (maximum load) = 3 ksf to 4 ksf
   Maximum column load (compressive) = 500 to 600 kips

2. Buildings (General)
   Maximum column load (compressive) = 20 to 80 kips
   Maximum uplift loads = 20 kips
   Maximum base shear = 10 to 20 kips

SCOPE OF WORK

The objectives of this investigation were 1) to explore the subsurface soil conditions by drilling 8 borings, 2) to evaluate the pertinent engineering characteristics of the soils encountered by laboratory testing, and 3) to perform engineering analyses to provide foundation design recommendations.

In order to accomplish these objectives, the following scope of work was undertaken:

1. A field exploration program of drilling, logging, and sampling 8 borings;

2. A laboratory testing program which included sieve analyses, Atterberg limits, Moisture-Density tests, consolidation tests, swell and collapse tests, strength tests including triaxial compression and direct shear tests, laboratory permeability tests, compaction tests, a CBR test and chemical tests for pH and soluble sulphate; and

3. Preparation of this report which includes;
   - a plot plan showing the boring location
   - log of borings
   - summary of field and laboratory test data
   - site conditions including surface and subsurface conditions and geologic setting
   - foundation design recommendations for shallow spread foundations including allowable bearing capacity, estimated settlements and lateral load resistance
   - drilled pile criteria for design to resist downward loads, uplift and lateral loads in soil
   - permissible increase in an allowable soil stresses for load combinations which include wind or seismic
   - sliding friction factor for concrete footings on soil
   - shear strength parameters including cohesion and angle of internal friction
   - site grading recommendations including fill placement and site preparation
   - discussion of anticipated construction problems
   - type of cement to be used for concrete
   - pavement design recommendations.

SITE CONDITIONS

SURFACE CONDITIONS

The site of the proposed facility is relatively level, and is presently utilized as a storage and parking area. A small building exists near the western end of the proposed site. The majority of the site area is covered with trash, debris and other equipment. A small area to the east of the site is paved with concrete to serve as a parking lot.

The site is bounded to the north by 26th Street and to the east by Indiana Street. A concrete lined existing ditch is located to the west of the site and a railroad track is located to the south of the site. The proposed site is located to the north of the existing facility of Gould Inc., Metals Division.

GEOLOGIC SETTING

The site lies within the recent flood plain of the Los Angeles River, but only a short distance south of a large area where older Upper Pleistocene terrace deposits outcrop at the surface. Therefore, the older deposits are encountered at a fairly shallow depth, on the order of 25 to 30 feet, under the site. The surface of these older deposits has been weathered to form red or brown soils which are frequently indurated or cemented. The older deposits are generally stiffer, denser, and less compressible than the overlying recent alluvium; however, in some cases, the red or brown soils have been disturbed and weakened since the Upper Pleistocene era and may have been eroded, transported and redeposited by local drainage during Recent times.

SUBSURFACE CONDITIONS

Our borings indicate that the site of the proposed facility is underlain by fill soils and interbedded alluvial deposits. The subsurface conditions may be generalized into the following principal strata:

Stratum 1. Brown silty fine to medium sand fill together with wire, metal, trash, wood and bricks is present up to 3 feet below the existing ground surface or below the concrete paving.

Stratum 2. Loose to medium dense silty fine to medium sand lies below a 3-foot depth and extends to an average depth of 20 to 25 feet. The laboratory tests show a minimal potential for collapse when these soils get saturated under the typical foundation loads.

This sand stratum also contains isolated pockets of fine sandy silt in variable thickness and at different elevations

Stratum 3. Stiff sandy silty clay lies below 20 to 25 feet depth and average about 5 to 10 feet in thickness.

Stratum 4. Stiff sandy silt to medium dense silty sand lies below 30-foot depth and average about 4 to 5 feet in thickness.

Stratum 5. Stiff to very stiff silty clay to fine sandy silt and medium dense silty sand lies below a depth of approximately 35 feet and its thickness ranges from 10 to 14 feet.

Stratum 6. Stiff to very stiff silty clay and sandy silt exists at an approximate depth of 48 feet and is 4 to 6 feet in average thickness.

Stratum 7. Very dense medium to coarse sand lies below an average depth of 50 feet and is about 10 feet in thickness.

Stratum 8. Very dense silty fine sand lies below an average depth of 60 feet to the depth explored. This silty sand stratum is interspersed with sandy silt and medium to coarse sands. These soils are in a very dense state of compactness.

Detailed descriptions of the soils encountered in each boring are presented on the Log of Borings included in the appendix. The generalized subsoil profile across the site is presented on Plate 3. The strength parameters are also summarized on Plate 3.

No ground water was encountered in the exploratory borings at the time of our field explorations.

DISCUSSIONS AND RECOMMENDATIONS

GENERAL

Based on the results of our soils investigation, observations during the site visit and our previous experience in this area, it is our opinion that the site is suitable for the proposed construction from a geotechnical standpoint. The existing fill contaminated with all sorts of debris must be removed and spoiled. Following the completion of the removal of the existing fill, the site must be brought to finished grade by placement of compacted fill. Lightly to moderately loaded structures, not unusually settlement sensitive or nor not subjected to significant over-turning, may be supported on conventional shallow foundations. Shallow foundations must be established in the compacted fill or in the natural alluvial materials at a minimum depth of 3 feet below the lowest adjacent design grade.

The heavier structures or structures subjected to significant uplift or overturning, will require drilled piles. These structures include blast furnace, lead receiving kettles, steel stack and similar structures.

If the heavily loaded structures were supported on shallow foundations, substantial total and differential settlements could occur. Therefore, we recommend that such footings be designed so that the footings can be adjusted or releveled, if required. The structural connections be made as flexible as possible. Detailed recommendations regarding site preparation, foundation design data and other pertinent recommendations are presented in the following sections of this report.

The recommendations presented in this report are for the soil conditions as encountered in our borings. Should other soil conditions due to nonuniformity of geologic formations or manmade depositions be encountered during construction, we should be consulted to evaluate if corrective measures are necessary.

SITE PREPARATION AND EARTHWORK

It is recommended that the trash, debris, and fill soils contaminated with debris be excavated, spoiled and replaced with compacted fill. Fill placement may be necessary to bring the site to the final design grade. Fill would also be required for some roadways and railroad spurs. Additional fill may be required to be placed outside the limits of the structures for drainage purposes. The site grades must be planned to permit rapid drainage of surface water runoff. The ground or fill surface should be sloped away from the structures to minimize ponding of water adjacent to the foundations.

Following the site clearing and stripping operations, the uncovered areas should be proof-rolled using heavy vibrating rollers or similar compacters. Wherever the fill is required to be placed over the stripped subgrade to bring the site to the design grade or for the construction of spurs, it is recommended that the fill be placed in horizontal layers no greater than 8 inches in loose thickness and compacted to at least 95% of the maximum dry density as determined by ASTM Designation: D1557 (Modified Proctor) Method of Compaction. Fill placed outside the structural areas should be compacted to 90% of the maximum dry density. The fill material should consist of predominantly granular material having less than 35% by weight passing No. 200 sieve.

Feasible slope inclinations for a temporary unbraced excavation will vary with soil properties and the excavation techniques employed. We expect that the slopes of 3/4 (horizontal) to 1 (vertical) or steeper may be feasible for excavations shallower than 4 feet. After excavating for foundations, any loose soils in the bottom of the excavation should be removed. Over excavation should be backfilled and recompacted to at least 95% of maximum dry density. If the excavation required is deeper, shoring or bracing of the excavation may be necessary. All excavations should satisfy the safety requirements of the State of California Construction Safety Orders, CAL-OSHA.

The soils excavated below the existing fill as a result of the required earthwork operations could be temporarily stockpiled near the battery hopper and truck dumper area where it would serve as a surcharge. Such surcharging would

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*American Society for Testing and Materials induce the natural soils to undergo some magnitude of settlement thus reducing the magnitude of the anticipated settlements under the imposed loads in this area. Later, the material from this stockpile could be used as a source of engineered fill.

FOUNDATIONS

SHALLOW FOUNDATIONS

The lightly to moderately loaded structures or buildings subjected to maximum column loads of up to 80 kips may be supported on shallow spread foundations following the site preparation and earthwork operations as described in the previous section. Footings should be a minimum of 2-foot wide and established a minimum depth of 3 feet below the lowest adjacent design grade. Allowable bearing capacities for shallow spread footings will vary with the footing depth and width. Spread footings may be proportioned using a minimal allowable bearing pressure of 3,000 pounds per square foot (psf). This allowable bearing pressure may be increased by 600 psf for each foot of increased footing width and by an additional 1,000 psf for each foot of increased footing depth, to a maximim of 5,000 psf. These recommended bearing values are net values. The weight of the foundation and backfill over the foundations need not be included when evaluating the foundation pressure.

For temporary loads resulting from seismic or wind forces, recommended bearing pressure may be increased by one-third. For foundations subjected to a moment, the result of the bearing pressures should fall within the middle one-third of the width of the foundation, and the maximum edge pressure should not exceed the allowable bearing value (with the one-third increase if due to seismic or wind).

Settlements of shallow spread foundations subjected to maximum column loads of up to 80 kips have been estimated to be less than an inch. Differential settlements between adjacent similarly loaded foundations are estimated not to exceed 1/2 inch. Due to the near surface granular nature of the subsurface soils, settlements are expected to occur rapidly during construction as the loads are applied. Long term settlements in this case should be negligible.

The uplift capacity of shallow spread foundations can be estimated by considering the weight of a cone having a frustum angle of 30° from the bottom of the foundation plus the weight of concrete in order to resist the uplift forces. The allowable uplift capacity may be increased by one-third for temporary loads such as those resulting from wind or seismic forces. The safety factor of 2 should be applied to obtain the allowable uplift loads.

DRILLED PILES

The settlement sensitive structures or heavily loaded structures may be supported on drilled piles. Curves showing the allowable downward capacity for drilled cast-in-place concrete piles of various size diameters are presented on Plate 4. Allowable uplift capacity may be taken as two-thirds of the allowable downward capacities. Allowable capacities shown may be increased by one-third for momentarily loading due to wind or seismic forces. The capacities shown are net capacities; therefore, in computing foundation loads, the weight of the pile itself may be neglected. No reduction in the capacity of an individual pile is required, provided its center-to-center spacing of at least 2 pile diameters is being maintained. Settlements of the cast-in-place piles are estimated to be less than 1/2 inch.

Excavations for drilled cast-in-place piles should be scheduled to permit the concrete in each pile to set before drilling an adjacent pile. Allowance for setting of adjacent piles is especially critical when center-to-center spacing of less than 3 pile diameters is used. Minor caving and ravelling may occur during drilling of the piles. The drilled pile shafts should be filled with concrete immediately after drilling.

LATERAL LOAD RESISTANCE

Resistance to lateral loads may be provided by shear resistance between the bottom of shallow concrete foundations and the underlying soils and/or by passive soil pressure developed against the sides of shallow foundations. For pile supported structures, resistance to lateral loads will be provided by the resistance of the soils against the pile which will result in bending stresses in the pile itself and resistance of pile caps and tie beams.

The coefficient of friction between the bottom of the concrete foundations and the underlying soil may be taken as 0.30. Passive pressures available in compacted fill and undisturbed natural soils may be taken as equal to the pressure exerted by a fluid weighing 300 pounds per cubic foot (pcf). Both of these values include a factor of safety of at least 1.5 and may be combined with no reduction to resist lateral forces.

The lateral capacities of cast-in-place piles of various diameters with the top of the pile either free (free-head) or restrained (fixed heads) from rotation, are presented below:

Pile Diameter (inches)	Lateral Capacity (kips) Free-Head	Fixed-Head
24	11	25
30	15	36
36	20	49

These pile capacities are for a pile cap deflection of 1/4-inch. For pile cap deflections up to 3/4-inch, lateral capacities will be directly proportional to the deflection.

LATERAL EARTH PRESSURES

Retaining walls should be designed to resist the active earth pressure exerted by the retained backfill plus any additional lateral forces that will be applied to the retaining walls due to the load placed at or near the concrete wall. The active pressure should be taken as equal to the pressure exerted by a fluid weighing 30 pcf.

SEISMIC DESIGN

Seismically, all of Southern California must be considered quite active and it must be expected that the site will, at some time, be subjected to seismic strong ground motion. The Newport-Inglewood fault zone passes approximately 8 miles southwest of the site, and the mapped portion of the Whittier Fault terminates approximately 8 miles east of the site.

We understand that the facilities will be designed in accordance with the 1979 Uniform Building Code. Minimum earthquake forces for structures are calculated by the formula:

$$V^{**} = Z\ I\ K\ C\ S\ W$$

The site lies within a seismic Zone 4; therefore, Z = 1.

The characteristic site period, T_s, and fundamental elastic periods of vibration of the structures will be used by the designers to calculate the seismic "S" factor. Based on evaluation of the subsurface profile as outlined in the 1979 UBC Standards, we recommend a value of $T_s = 2$ seconds for use in calculating the seismic factor "S".

FLOOR SLABS

Floor slabs should be placed on at least 4 inches of free draining gravel or crushed rock, compacted to at least 95 percent over a subgrade prepared as recommended. If moisture penetration through the floor slab is undesirable, moisture proofing or a vapor barrier should be installed to prevent condensation from penetrating through the slab. Construction joints should be keyed or doweled where heavy wheel loads or storage loads are anticipated.

PAVEMENT SECTIONS

Pavement sections bearing on the subgrade prepared as recommended earlier, may be designed using a California Bearing Ratio (CBR) of 12. The subgrade must be compacted to 95 percent of the maximum dry density as determined by ASTM Designation: D: 1557 , Method of Compaction.

** For definitions, see Uniform Building Code 1979

RAILROAD SPUR SECTIONS

We recommend that the proposed railway spur be constructed over a subgrade compacted to 95 percent, and that it be designed in accordance with the standard railway specifications for railway spurs, which require at least 6 inches of base rock below the railroad ties.

CHEMICAL TESTS

The chemical tests performed on soil samples collected from our borings are presented below:

Boring	Depth (in feet)	pH	Soluble Sulphates (%)
B-2	14.0	4	0.26
B-5	9.0	8	0.06

Based on the results of the soluble sulphate tests, we feel that the attack on concrete by sulphates will be considerable. Therefore, we recommend that type V Portland cement should be used for all concrete in contact with natural materials.

The pH test results indicate that the soils will be corrosive to metallic pipes in some locations. In views of this, we recommend that a corrosion study be performed if any underground metal pipes are planned at the site. In any case, corrosion protection will be necessary for metallic elements in contact with the natural soils.

If additional chemical tests on some of the soil samples are required for your use, we would be quite happy to perform such tests.

INSPECTION OF EARTHWORK AND FOUNDATION CONSTRUCTION

We recommend that all earthwork and foundation construction be inspected by a qualified geotechnical engineer. This includes inspecting the excavation and recompaction of loose soils, placement of compacted fill, and all shallow foundation and any drilled pile excavations. It is particularly important that the full extent of loose soils within the foundation influence is completely recompacted. If the bottom two feet of loose soil is recompacted inplace, it is important that the depth of excavation be determined by probing or other means during the construction.

It is also recommended that the foundation plans and specifications be reviewed by a qualified foundation engineer.

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The following plates are attached and complete this report:

Plate 1	Vicinity Map
Plate 2	Plot Plan
Plate 3	Generalized Subsoil Profile
Plate 4	Allowable Capacities of Drilled Piles
Appendix	Field Explorations and Laboratory Testing

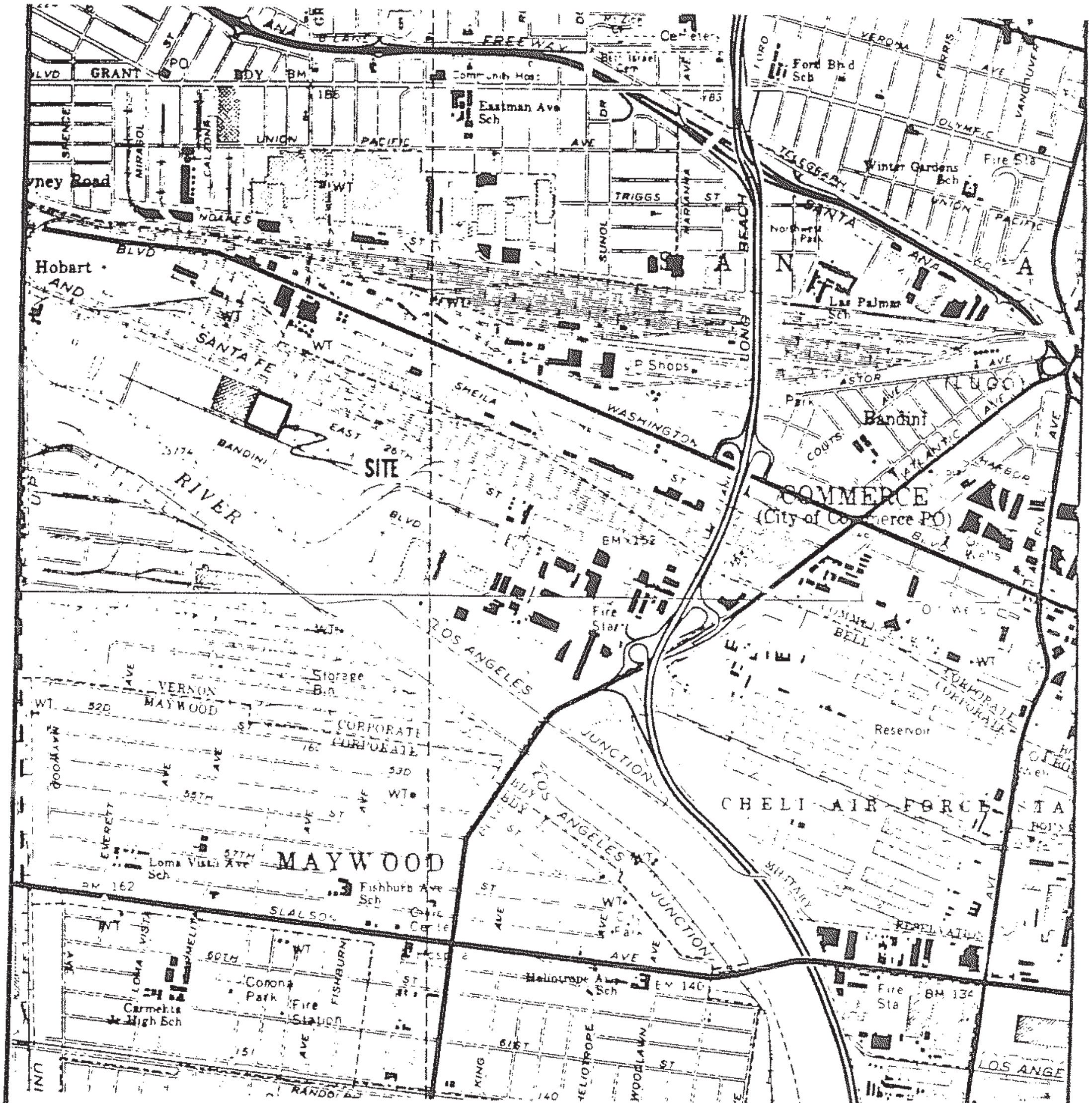
Very truly yours,

DAMES & MOORE

Mohammad A. Latif
Associate

Charles V. Logie
Partner

MAL:CVL:sj



1000 0 1000 2000 3000 4000 5000 6000 7000

SCALE IN FEET

VICINITY MAP

REFERENCE: USGS 7-1/2 MINUTE QUADRANGLES, SOUTH GATE &
LOS ANGELES, PHOTOREVISED 1972

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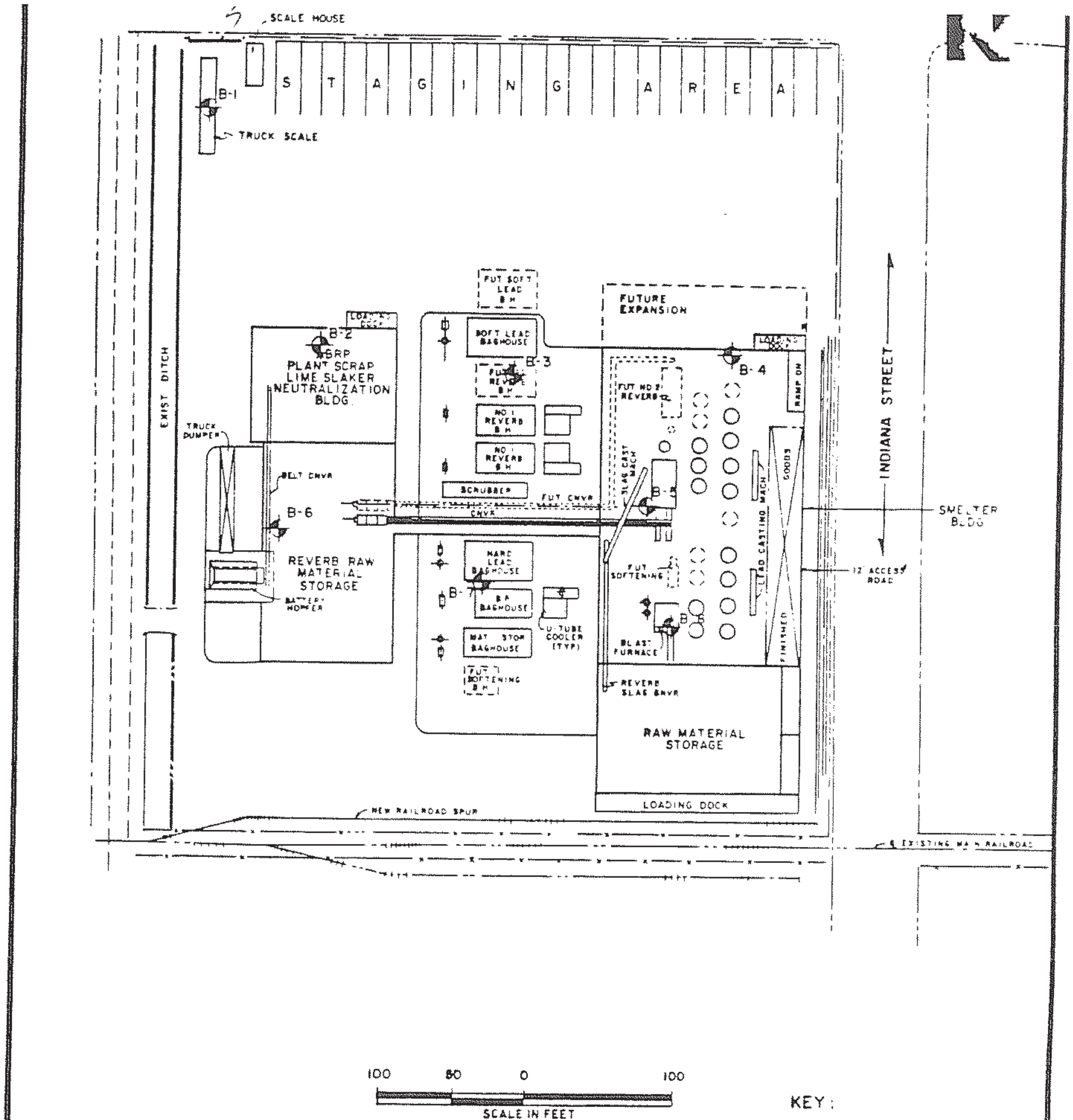
PLATE 1



KEY:

B-1 DENOTES BORING LOCATION AND NUMBER

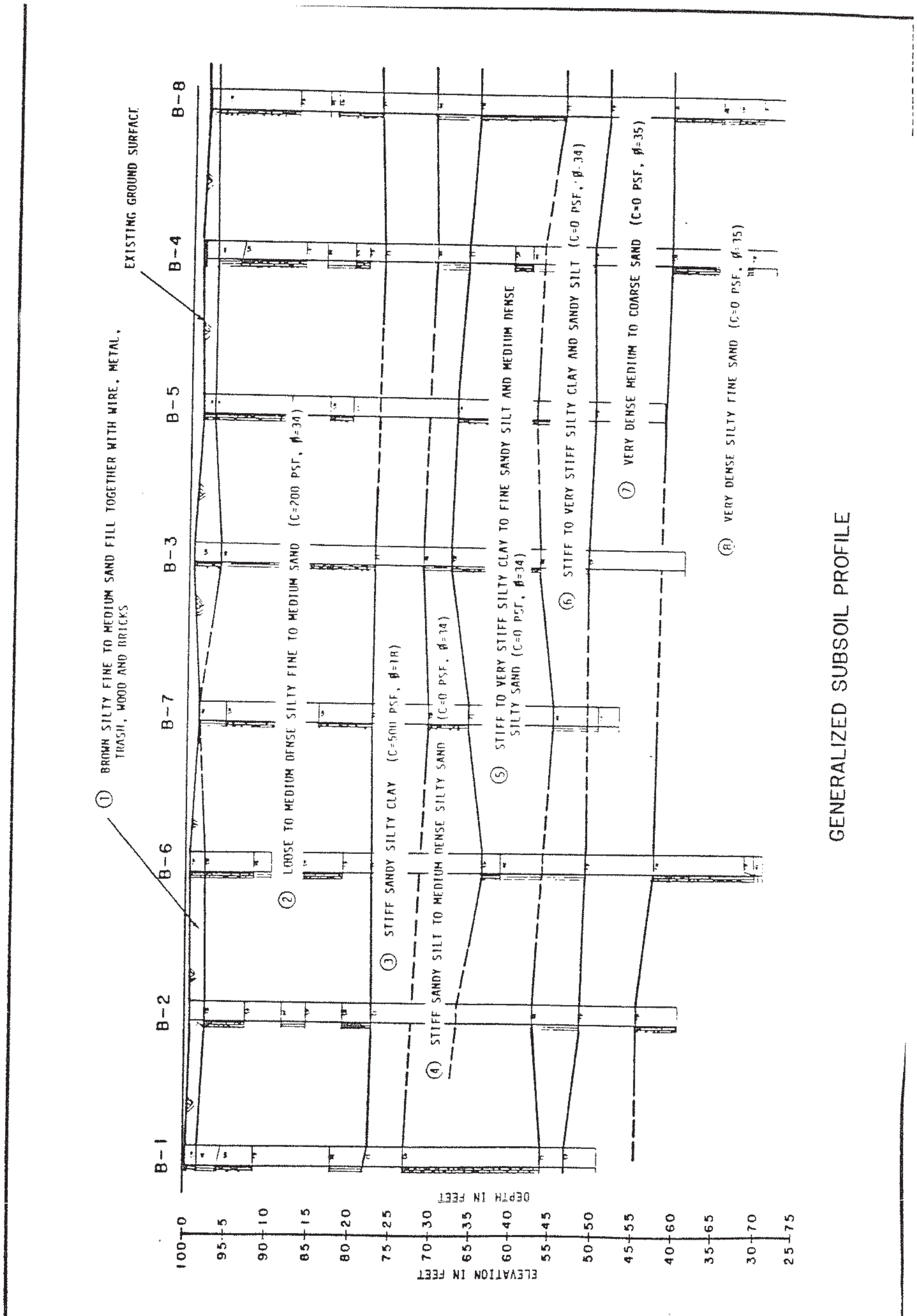
PLOT PLAN

PROPOSED WEST COAST SMELTER
GOULD INC., METALS DIV.
VERNON, CALIFORNIA

REFERENCE: DRAWING ENTITLED "SOIL BORING LOCATION PLAN" DATED 1-30-80, DRAVO NO. SK-DC-001

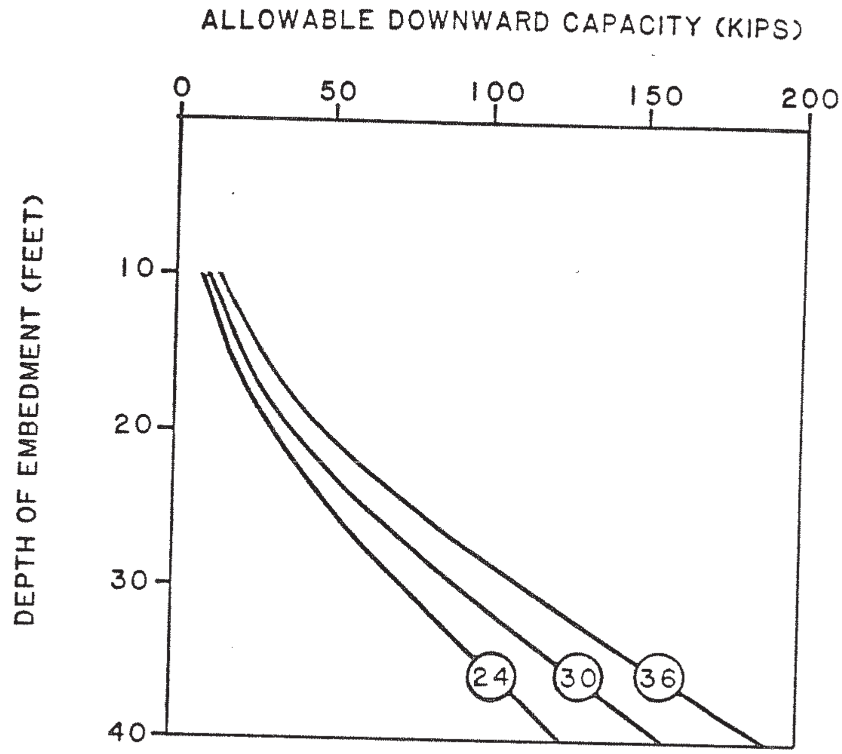
DAMES & MOORE

PLATE 2



EXISTING GROUND SURFACE
B-1
B-2
B-6
B-7
B-3
B-5
B-4
B-8
① BROWN SILTY FINE TO MEDIUM SAND FILL TOGETHER WITH WIRE, METAL, TRASH, WOOD AND BRICKS
② LOOSE TO MEDIUM DENSE SILTY FINE TO MEDIUM SAND (C=200 PSF, Ø=34)
③ STIFF SANDY SILTY CLAY (C=500 PSF, Ø=18)
④ STIFF SANDY SILT TO MEDIUM DENSE SILTY SAND (C=0 PSF, Ø=34)
⑤ STIFF TO VERY STIFF SILTY CLAY TO FINE SANDY SILT AND MEDIUM DENSE SILTY SAND (C=0 PSF, Ø=34)
⑥ STIFF TO VERY STIFF SILTY CLAY AND SANDY SILT (C=0 PSF, Ø=34)
⑦ VERY DENSE MEDIUM TO COARSE SAND (C=0 PSF, Ø=35)
⑧ VERY DENSE SILTY FINE SAND (C=0 PSF, Ø=35)
ELEVATION IN FEET
DEPTH IN FEET
100 95 90 85 80 75 70 65 60 55 50 45 40 35 30 25
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75
GENERALIZED SUBSOIL PROFILE

PLATE 3



NOTES: 1. CIRCLED NUMBERS ARE PILE DIAMETERS IN INCHES.
2. FACTOR OF SAFETY = 2.0.
3. THE ALLOWABLE CAPACITIES MAY BE INCREASED BY ONE-THIRD FOR MOMENTARY LOADING DUE TO WIND OR SEISMIC FORCES.
4. ALLOWABLE UPLIFT CAPACITIES MAY BE TAKEN AS TWO-THIRDS THE ALLOWABLE DOWNWARD CAPACITIES.

ALLOWABLE CAPACITIES OF DRILLED PILES

DAMES & MOORE

PLATE 4

APPENDIX

FIELD EXPLORATIONS AND LABORATORY TESTS

FIELD EXPLORATIONS

The subsurface conditions at the site were explored by drilling eight borings to depths of 50 to 70-1/2 feet at the locations shown on the Plot Plan, Plate 2. The borings were 24 inches in diameter and were drilled with a truck-mounted bucket-auger rig equipped with a triple telescoping kelly that permits rapid drilling and sampling to a depth of about 75 feet. This is the type of rig commonly used for installation of caissons and drilled piles. Some caving of the sides of the borings was encountered, as noted on the boring logs. The caving was not severe, and the water table was not encountered within the depths explored; therefore, drilled piles are a viable alternative foundation for this site. All of the borings were backfilled and tamped upon completion.

The field engineering was directly supervised by an engineer from our Los Angeles office, who logged the borings and obtained undisturbed and bulk samples for examination and testing. Samples for heavy metals analysis were taken from each foot in the top 3 feet of soil cover in each boring and provided to Gould's Plant Superintendent at the job site. The undisturbed samples were obtained using a Dames & Moore Soil Sampler Type U, illustrated on Plate A-3. The soils were classified in accordance with the system described on Plate A-4. The boring logs are presented on Plates A-1A through A-1H. Keys to the Log of Borings and laboratory tests are presented on Plate A-2.

The boring location and elevation of the ground surface at each location were surveyed by Pafford Associates. The elevations are based on an assumed datum as described on Plate A-2.

LABORATORY TESTS

Laboratory tests included direct shear and triaxial compression tests to measure soil strengths, consolidation (confined compression) tests to provide data for evaluating settlements, and collapse and expansion tests to evaluate the effects of saturation on the shallow soils. Atterberg limits, sieve, and hydrometer tests were performed to aid in soil classification and, along with moisture-density tests, for correlation purposes. Permeability tests were performed on two shallow samples to measure the drainage (percolation) characteristics. Compaction and CBR tests were performed for pavement studies, and a few chemical tests were performed to evaluate possible deleterious effects on concrete and steel buried in the ground.

DIRECT SHEAR AND TRIAXIAL COMPRESSION TESTS

The strength tests were performed in accordance with the procedures described on Plates A-9 and A-10. All of the tests were "unconsolidated-undrained" tests on samples at field moisture content. The results are presented on the boring logs.

CONSOLIDATION TESTS

The consolidation tests were performed in an oedometer as described on Plate A-11. The shallow sample from Boring B-7 was tested at field moisture content. The remainder were inundated since the soils were nearly saturated at field moisture content and might shrink if allowed to dry out. The results of these tests are presented on Plate A-7.

COLLAPSE-EXPANSION TESTS

These tests were also performed in an oedometer. The samples were initially loaded to pressures approximating existing overburden pressures or anticipated foundation or storage pressures, and then unundated to evaluate any tendency to expend or collapse. The soils were found to have negligible collapse and expansion characteristics. The test results are tabulated as follows:

Boring	Depth (Feet)	Soil Type	Surcharge Pressure (PSF)	*Percent Collapse or Expansion
B-2	3-1/2	SM	400	+0.03
B-3	5-1/2	ML	600	-0.13
B-4	1-1/2	ML	400	-0.05
B-4	9-1/2	SM	1100	-0.14
B-8	3-1/2	SM	3000	-0.20

CLASSIFICATION TESTS

Atterberg limits (liquid and plastic limits) were performed in accordance with ASTM** D 423-66 and D 424-59. Sieve and hydrometer tests (gradation) were performed in accordance with ASTM D 422-63. The Atterberg limits are presented on the Log of Borings. Gradation curves are presented on Plates A-5.

PERMEABILITY TESTS

The permeability (percolation) test method is described on Plate A-12. The results are as follows

Boring	Depth (Feet)	Soil Type	Type of Test	Surcharge Pressure (PSF)	Coefficient of Permeability (cm./sec.)
B-1	9-1/2	SP	Pch	1100	10^{-4}
B-3	9-1/2	ML	pfh	1100	10^{-5}

PAVEMENT DESIGN TESTS

Compaction and California Bearing Ratio (CBR) tests were performed on bulk samples of the upper 3 feet of soils in accordance with ASTM D 1557-78 and D 1883-73, respectively. The results are presented on Plate A-6. The method of performing compaction tests is presented on Plate A-8.

---

* Minus designates collapse; plus designates expansion

** American Society for Testing and Materials

CHEMICAL TESTS

Chemical tests (pH and soluble sulfates) on two representative samples were subcontracted to AgriScience Laboratories in Los Angeles. The results are:

Boring	Depth (Feet)	Soil Type	pH	Soluble Sulfates
B-2	14	SP	4	0.26%
B-5	9	SM	8	0.06%

o o o

The following plates are attached and complete this Appendix:

Plate A-1A through A-1H	Log of Borings
Plate A-2	Key to Log of Borings
Plate A-3	Soil Sampler Type U
Plate A-4	Unified Soil Classification System
Plate A-5	Gradation Curves
Plate A-6	Pavement Design Tests
Plate A-7	Consolidation Test Data
Plate A-8	Method of Performing Compaction Tests
Plate A-9	Method of Performing Direct Shear and Friction Tests
Plate A-10	Method of Performing Unconfined Compression and Triaxial Tests
Plate A-11	Method of Performing Consolidation Tests
Plate A-12	Method of Performing Percolation Tests

BORING B-1

SURFACE ELEVATION: 99.6 FEET

LABORATORY TEST DATA

DEPTH IN FEET	TESTS REPORTED ELSEWHERE	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	STRENGTH TEST DATA: TYPE OF TEST	STRENGTH TEST DATA: NORMAL OR CONFINING PRESSURE (PSF)	STRENGTH TEST DATA: SHEAR STRENGTH (PSF)	STRENGTH TEST DATA: DEVIATOR STRESS (PSF)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	BLOWS/FT.
0										2
										2
								16.0	94	W
5										
			NP					7.0	98	3
10	P_{ch}									
										3
15				DS	1700 3400	1750 2950		15.4	105	2
20										2
25				TX/UU	2900		3050	23.8	99	W
30										5
35								17.0	113	6
40										11
45		33	14					24.0	104	8
50										62/8"
55										

SYMBOLS / DESCRIPTION

SYMBOLS	DESCRIPTION
SM	GREYISH-BROWN SILTY FINE SAND - FILL (LOOSE)
ML	DARK BROWN FINE SANDY SILT WITH TRACES OF SMALL ROOTS AND ROOT HOLES TO 5 FEET (LOOSE) GRADES TO
SM	BROWN SILTY FINE SAND(MEDIUM DENSE)
SP	GREYISH TAN WITH RUST STREAKS FINE SAND (MEDIUM DENSE)
ML	BROWN FINE SANDY SILT WITH TRACE OF DECOMPOSED VEGETATION (MEDIUM STIFF)
CL	GRADES TO DARK REDDISH-BROWN SANDY SILTY CLAY (STIFF)
SM	REDDISH-BROWN SILTY FINE TO MEDIUM SAND, TRACE OF SMALL GRAVEL (MEDIUM DENSE) GRADES TO SILTY FINE SAND GRADES TO SILTY FINE TO MEDIUM SAND (DENSE)
CL	MOTTLED REDDISH-BROWN AND TANNISH-GREY SANDY SILTY CLAY (VERY STIFF)
SP	TAN MEDIUM SAND (VERY DENSE)

BORING COMPLETED ON 3/10/80
SOME CAVING, 6' - 10'
NO WATER

KEY TO LABORATORY TESTS:

DS: DIRECT SHEAR TESTS AT FIELD MOISTURE
TX/UU: TRIAXIAL COMPRESSION TESTS AT FIELD MOISTURE
C: CONSOLIDATION (CONFINED COMPRESSION) TESTS
COL: COLLAPSE TEST
EXP: EXPANSION TEST
AL: ATTERBERG LIMITS
SA: SIEVE ANALYSIS
HA: SIEVE AND HYDROMETER ANALYSIS
P_{ch}: CONSTANT HEAD PERMEABILITY TEST
P_{fh}: FALLING HEAD PERMEABILITY TEST
COMP: COMPACTION TEST - ASTM D 1557-78
CBR: CALIFORNIA BEARING RATIO - ASTM D 1883-73
CHEM: PH, SOLUBLE SULFATES

LOG OF BORINGS

DAMES & MOORE

PLATE A-1A

BORING B-2

SURFACE ELEVATION: 99.3 FEET

LABORATORY TEST DATA

DEPTH IN FEET	TESTS REPORTED ELSEWHERE	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	STRENGTH TEST DATA: TYPE OF TEST	STRENGTH TEST DATA: NORMAL OR CONFINING PRESSURE (PSF)	STRENGTH TEST DATA: SHEAR STRENGTH (PSF)	STRENGTH TEST DATA: DEVIATOR STRESS (PSF)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)
5	EXP							3.9	102
				DS	600 900	800 1000		9.1	100
10								9.0	96
15	CHEM							6.9	99
20				DS	2300 4000	2750 4350		11.3	120
40	C	27	12					20.0	111
45								23.0	103
50								6.0	111

BLOWS/FT.	SAMPLES
3	■
2	■
2	■
3	■
2	■
4	■
W	■
5	■
11	■
10	■
5	■
83	■
94/11"	■
65	■

SYMBOLS	DESCRIPTION
	FILL-PLASTIC, METAL, WOOD, BRICKS, WIRE
SM	BROWN SILTY FINE SAND (MEDIUM DENSE)
SP	TAN FINE TO MEDIUM SAND (MEDIUM DENSE)
ML	BROWN FINE SANDY SILT (MEDIUM DENSE)
SP	TAN FINE SAND (MEDIUM DENSE)
SM	DARK BROWN SILTY FINE TO MEDIUM SAND (DENSE)
CL	DARK BROWN SANDY SILTY CLAY (STIFF) COLOR CHANGES TO REDDISH-BROWN AT 27' GRADES TO (VERY STIFF)
ML	YELLOWISH BROWN FINE SANDY SILT, SLIGHTLY MICACEOUS (STIFF)
SP	TAN MEDIUM TO COARSE SAND (VERY DENSE)
SM	MOTTLED GREYISH-TAN AND RUST SILTY FINE SAND (VERY DENSE)

BORING COMPLETED ON 3/13/80
SLIGHT CAVING, UPPER 20'
NO WATER

LOG OF BORINGS

DAMES & MOORE

PLATE A-1B

BORING B-3

SURFACE ELEVATION: 99.4 FEET

LABORATORY TEST DATA

DEPTH IN FEET	TESTS REPORTED ELSEWHERE	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	STRENGTH TEST DATA: TYPE OF TEST	STRENGTH TEST DATA: NORMAL OR CONFINING PRESSURE (PSF)	STRENGTH TEST DATA: SHEAR STRENGTH (PSF)	STRENGTH TEST DATA: DEVIATOR STRESS (PSF)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)
5–10	COL							11.4	98
10	P_{fh}								
25				TX/UU	2900		4000	19.9	106
35				DS	4000 6000	3400 4300		16.9	115
50	SA							6.1	107

BLOWS/FT.
4
W
W
2
2
1
3
W
3
10
8
6
66
115
75/9"

SYMBOLS	DESCRIPTION
SM	FILL-GREYISH BROWN SILTY FINE SAND WITH WOOD, GLASS, WIRE ETC. (LOOSE)
ML	BROWN FINE SANDY SILT (MEDIUM DENSE)
	MICACEOUS
SM	GREYISH-BROWN SILTY FINE SAND, MICACEOUS (MEDIUM DENSE)
	OCCASIONAL SILT LAYERS
	GRADES TO DARK BROWN SILTY FINE TO MEDIUM SAND (DENSE)
CL	DARK BROWN SANDY SILTY CLAY (STIFF)
ML	MOTTLED REDDISH-BROWN AND GREYISH-TAN FINE SANDY SILT (STIFF)
SM	REDDISH-BROWN SILTY FINE SAND (DENSE)
	GRADES TO SILTY FINE TO MEDIUM SAND
ML	MOTTLED YELLOWISH-BROWN AND BROWN FINE SANDY SILT (VERY STIFF)
SP	TAN MEDIUM TO COARSE SAND (VERY DENSE)

BORING COMPLETED ON 3/11/80
SLIGHT CAVING, 7'-14'
NO WATER

LOG OF BORINGS

DAMES & MOORE

SURFACE ELEVATION 98.9 FEET

DEPTH IN FEET	TESTS REPORTED ELSEWHERE	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	STRENGTH TEST DATA: TYPE OF TEST	STRENGTH TEST DATA: NORMAL OR CONFINING PRESSURE (PSF)	STRENGTH TEST DATA: SHEAR STRENGTH (PSF)	STRENGTH TEST DATA: DEVIATOR STRESS (PSF)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	BLOWS/FT.
0	COL							12.5	108	2
5										M
								10.7	95	1
10	COL							2.8	100	2
15				DS	1700 2500	1200 2250		33.8	88	2
20										3
25				TX/UU	4300		7600	18.9	108	1
30										5
35										11
40										13
45										13
50										64
55								6.0	108	73
60										70/10"
65										77
70	SA							4.0	118	90/8"
75										

SYMBOLS	DESCRIPTION
	4" THICK CONCRETE SLAB FILL
ML	BROWN FINE SANDY SILT (LOOSE) GRADES-TO
SM	BROWN SILTY FINE SAND WITH SOME VERY FINE ROOTS AND SMALL ROOT HOLES (MEDIUM DENSE) GRADES TO MOTTLED GREYISH-TAN AND TAN AND SLIGHTLY MICACEOUS
SP	TAN FINE TO MEDIUM SAND WITH SOME GRAVEL (MEDIUM DENSE)
ML	BROWN FINE SANDY SILT (MEDIUM STIFF)
SM	DARK BROWN SILTY MEDIUM TO COARSE SAND (MEDIUM DENSE)
SP	TAN FINE SAND (DENSE)
CL	DARK BROWN SANDY SILTY CLAY, SLIGHTLY MICACEOUS (STIFF)
ML	REDDISH-BROWN FINE SANDY SILT (STIFF)
CL	REDDISH-BROWN SILTY CLAY (VERY STIFF)
SM	REDDISH-BROWN SILTY FINE SAND WITH TRACE OF CLAY (DENSE)
ML	REDDISH-BROWN CLAYEY SILT (VERY STIFF) GRADES TO YELLOWISH-BROWN FINE SANDY SILT
SP	TAN MEDIUM TO COARSE SAND (VERY DENSE)
SM	BROWN SILTY FINE TO MEDIUM SAND (VERY DENSE)
SP	LIGHT BROWN FINE TO MEDIUM SAND (VERY DENSE)

BORING COMPLETED ON 3/12/80
SLIGHT CAVING
NO WATER

LOG OF BORINGS

DAMES & MOORE

PLATE A-1D

LABORATORY TEST DATA

BORING B-5

SURFACE ELEVATION: 98.1 FEET

TESTS REPORTED ELSEWHERE	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	TYPE OF TEST	NORMAL OR CONFINING PRESSURE (PSF)	SHEAR STRENGTH (PSF)	DEVIATOR STRESS (PSF)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	BLOWS/FT.
									3
MA									3
							13.0	92	4
							9.6	95	2
CHEM							9.3	95	2
			DS	1500 2500	1350 1950		6.1	92	1
									2
									1
							22.0	103	4
									6
									8
									7
									5
			DS	6000 10000	5500 8650		11.5	115	64
							20.0	107	28

DEPTH IN FEET: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60

SAMPLES / SYMBOLS / DESCRIPTION

- SM — FILL-BROWN SILTY FINE SAND (LOOSE)
- SM — BROWN SILTY FINE SAND (MEDIUM DENSE)
  - (LOOSE)
  - (MEDIUM DENSE)
- SP — LIGHT BROWN FINE TO MEDIUM SAND (LOOSE)
- SM — GREYISH-BROWN WITH IRON STAINS SILTY FINE SAND (MEDIUM DENSE)
- CL — DARK BROWN SANDY SILTY CLAY (STIFF)
  - GRADES TO REDDISH-BROWN
- SM — REDDISH-BROWN SILTY FINE TO MEDIUM SAND (MEDIUM DENSE)
- SC — REDDISH-BROWN CLAYEY SAND (DENSE)
- SM — REDDISH-BROWN SILTY FINE SAND (DENSE)
- ML — MOTTLED YELLOWISH-TAN AND BROWN FINE SANDY SILT (STIFF)
- SP — REDDISH-BROWN MEDIUM TO COARSE SAND WITH SOME SMALL GRAVEL (VERY DENSE)
  - LENSE OF SILTY SAND

BORING COMPLETED ON 3/12/80
CONSIDERABLE CAVING 4' TO 14'
NO WATER

LOG OF BORINGS

DAMES & MOORE

PLATE A-1E

BORING B-6

SURFACE ELEVATION: 99.5 FEET

LABORATORY TEST DATA

DEPTH IN FEET	TESTS REPORTED ELSEWHERE	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	STRENGTH TEST DATA: TYPE OF TEST	NORMAL OR CONFINING PRESSURE (PSF)	SHEAR STRENGTH (PSF)	DEVIATOR STRESS (PSF)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)
0									
	MA							11.0	93
5									
10				DS	1100	1150		22.5	9.5
				DS	1100	1200		9.0	100
15	C,MA							10.9	100
20									
25	C	34	15					24.3	99
30									
35				TX/UU	4300		17000	14.4	120
40								16.0	117
45									
50				DS	5500 7500	5650 7350		4.0	110
55									
60									
65								12.0	120
70									
75									

BLOWS/FT. / SAMPLES

BLOWS/FT.	SAMPLES
5	■
2	■
1	■
2	■
W	■
2	■
5	■
W	■
3	■
12	■
10	■
10	■
50	■
75/9"	■
95/9"	■
51	■
38	■

SYMBOLS - DESCRIPTION

SYMBOLS	DESCRIPTION
SM	FILL-GREYISH-BROWN SILTY MEDIUM SAND WITH WIRE, METAL, TRASH ETC. (LOOSE)
SM	BROWN SILTY FINE SAND (MEDIUM DENSE)
ML	BROWN FINE SANDY SILT WITH SMALL ROOT HOLES (LOOSE
SP	TAN FINE TO MEDIUM SAND (MEDIUM DENSE)
SM	BROWN SILTY FINE SAND (MEDIUM DENSE)
SP	TAN FINE TO MEDIUM SAND (MEDIUM DENSE)
CL	DARK BROWN FINE SANDY SILTY CLAY (STIFF)
	GRADES TO REDDISH-BROWN
SM	REDDISH-BROWN SILTY FINE TO MEDIUM SAND (DENSE
ML	REDDISH-BROWN FINE SANDY SILT (VERY STIFF)
SP	TAN MEDIUM TO COARSE SAND WITH SOME GRAVEL (VERY DENSE)
SM	GREYISH-TAN WITH IRON STAIN SILTY FINE SAND (VERY DENSE)
SP	GREYISH-TAN FINE TO MEDIUM SAND (DENSE)
ML	GREYISH-TAN FINE SANDY SILT (VERY STIFF)

BORING COMPLETED ON 3/10/80
SLIGHT CAVING UPPER 15'
NO WATER

LOG OF BORINGS

DAMES & MOORE

PLATE A-1F

BORING B-7

SURFACE ELEVATION: 98.2 FEET

LABORATORY TEST DATA

DEPTH IN FEET	TESTS REPORTED ELSEWHERE	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	STRENGTH TEST DATA: TYPE OF TEST	STRENGTH TEST DATA: NORMAL OR CONFINING PRESSURE (PSF)	STRENGTH TEST DATA: SHEAR STRENGTH (PSF)	STRENGTH TEST DATA: DEVIATOR STRESS (PSF)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)
5	C			DS	500	750		9.0	95
10				TX/UU	1150		5200	28.0	92
15								14.0	101
25				TX/UU	5750		6700	20.6	104
35								15.0	119
45								23.0	10[illegible]

BLOWS/FT.	SAMPLES	SYMBOLS	DESCRIPTION
1	▩	ML	BROWN FINE SANDY SILT (MEDIUM STIFF)
W	▩		
1	▩	SM	BROWN SILTY FINE SAND (MEDIUM DENSE)
2	▩		THIN STREAKS OF FINE SANDY SILT
1	▩		
		SP	LIGHT BROWN FINE TO MEDIUM SAND MEDIUM DENSE
3	▩	SM	BROWN SILTY FINE SAND (MEDIUM DENSE)
3	▩		GRADES TO DARK BROWN SILTY FINE TO MEDIUM SAND
		CL	BROWN FINE SANDY SILTY CLAY (STIFF)
W	▩		
4	▩	SM	REDDISH-BROWN SILTY FINE TO MEDIUM SAND WITH TRACE OF CLAY (MEDIUM DENSE)
14	▩	CL	REDDISH-BROWN SANDY CLAY (VERY STIFF)
11	▩	CL	REDDISH-BROWN SANDY SILTY CLAY (VERY STIFF)
8	▩	ML	BROWN WITH RUST STREAKS FINE SANDY SILT (STIFF)
72	▩	SP	TAN MEDIUM TO COARSE SAND WITH SOME SMALL GRAVEL (VERY DENSE)

BORING COMPLETED ON 3/11/80
SOME CAVING 5' to 15'
NO WATER

LOG OF BORINGS

DAMES & MOORE

PLATE A-1G

LABORATORY TEST DATA

Depth in Feet	Tests Reported Elsewhere	Atterberg Limits: Liquid Limit (%)	Atterberg Limits: Plasticity Index (%)	Strength Test Data: Type of Test	Strength Test Data: Normal or Confining Pressure (PSF)	Strength Test Data: Shear Strength (PSF)	Strength Test Data: Deviator Stress (PSF)	Moisture Content (%)	Dry Density (PCF)
5	COL							11.5	100
				DS	1000 2000	1150 1900		9.1	100
10				DS	1200 2400	1150 1800		29.8	94
25	C	32	17					22.6	103
30				DS	3500	1900		19.0	111
35				DS	4000	3850		15.9	117
45				TX/UU	5400		19600	19.4	112
50				DS	5700 8700	5300 7000		4.9	110

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75

BORING B-8

SURFACE ELEVATION: 98.1 FEET

Blows/Ft.	Samples
W	■
W	■
2	■
2	■
1	■
3	■
W	■
5	■
7	■
9	■
15	■
46	■
76	■
110	■
43	■
80/11"	■

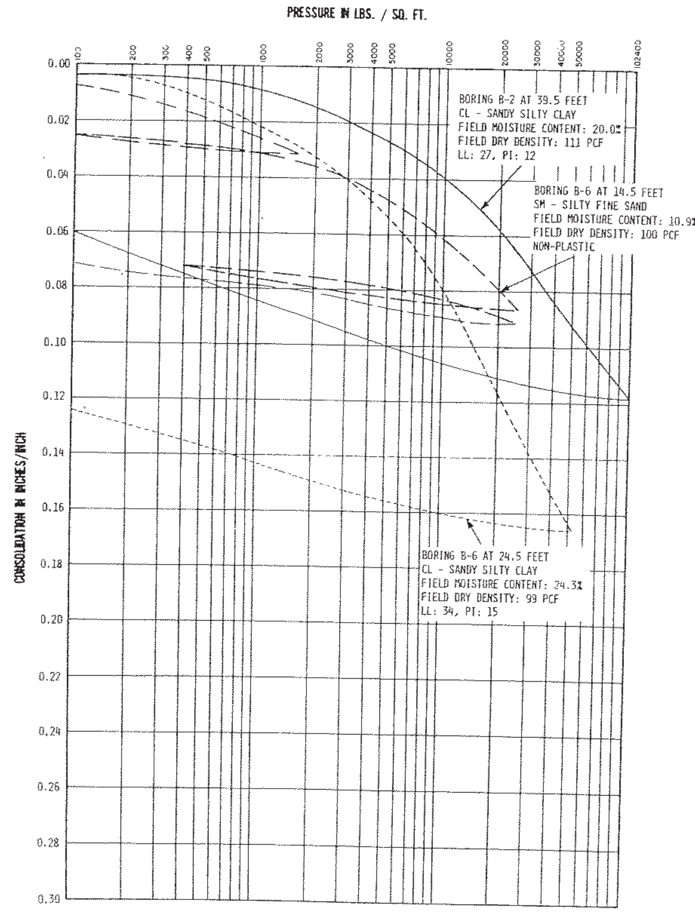
Symbols	Description
	? A... ING AN... ST BASE
SM	BROWN SILTY FINE SAND, TRACE OF SMALL ROOTS AND ROOT HOLES (LOOSE)
	GRADES (MEDIUM DENSE)
SP	TAN FINE TO MEDIUM SAND (MEDIUM DENSE)
ML	BROWN SILT WITH SOME SMALL ROOT HOLES (MEDIUM STIFF)
SM	BROWN SILTY MEDIUM TO COARSE SAND (DENSE)
CL	BROWN FINE SANDY SILTY CLAY (STIFF)
ML	REDDISH-BROWN SANDY CLAYEY SILT (STIFF)
SM	REDDISH-BROWN SILTY MEDIUM SAND (DENSE)
	GRADES TO SILTY FINE TO MEDIUM SAND
CL	BROWN TO GREYISH-BROWN SANDY SILTY CLAY (VERY STIFF)
SP	TAN MEDIUM TO COARSE SAND WITH SOME GRAVEL (VERY DENSE)
SM	BROWN SILTY FINE TO MEDIUM SAND (VERY DENSE)
ML	YELLOWISH-TAN FINE SANDY SILT (VERY STIFF)
SM	YELLOWISH-TAN SILTY FINE SAND (VERY DENSE)
SP	GREYISH-TAN MEDIUM TO COARSE SAND (VERY DENSE)

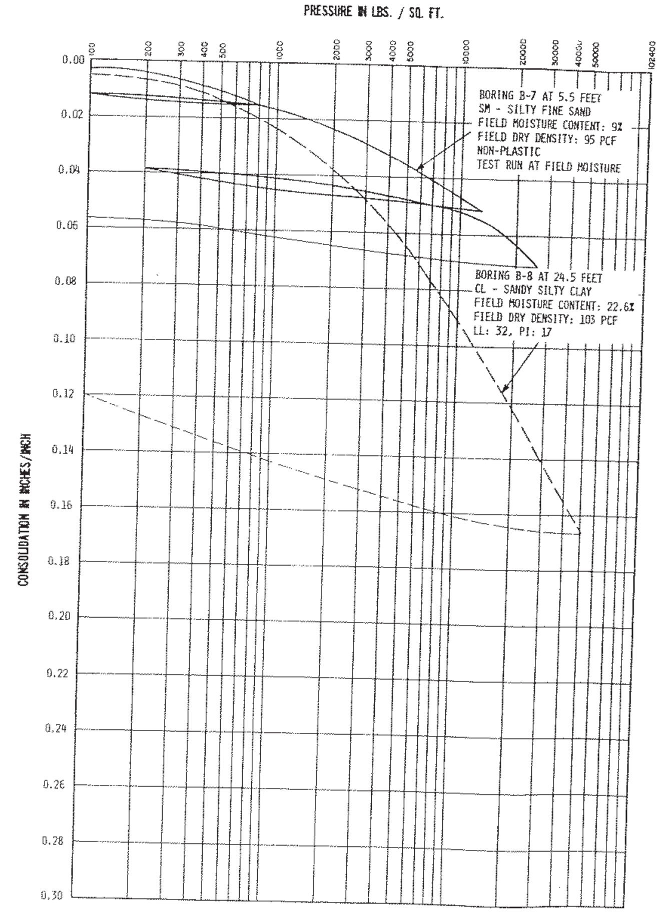
BORING COMPLETED ON 3/13/80
SLIGHT CAVING 6' TO 20'
NO WATER

LOG OF BORINGS

DAMES & MOORE

PLATE A-1H





CONSOLIDATIO

SAMPLES AND BLOW COUNTS

■ UNDISTURBED SAMPLES
□ SAMPLING ATTEMPT WITH NO RECOVERY

BLOWS/FT. INDICATES NUMBER OF BLOWS OF WEIGHT (KELLY BAR) DROPPING 12 INCHES REQUIRED TO DRIVE D&M TYPE U SAMPLER 12 INCHES.

A 2700 LB. WT. WAS USED FROM 0-25 FEET.
A 1700 LB. WT. WAS USED FROM 25-45 FEET.
AN 800 LB. WT. WAS USED BELOW 45 FEET.
W INDICATES SAMPLER ADVANCED UNDER WEIGHT OF KELLY

SOIL CONSISTENCY

COMPACTNESS OF GRANULAR SOILS

	RELATIVE DENSITY (%)
VERY LOOSE	0 TO 15
LOOSE	15 TO 40
MEDIUM DENSE	40 TO 70
DENSE	70 TO 85
VERY DENSE	85 TO 100

CONSISTENCY OF PLASTIC SOILS

	SHEAR STRENGTH IN LB./SQ. FT.
VERY SOFT	LESS THAN 250
SOFT	250 TO 500
MEDIUM STIFF	500 TO 1000
STIFF	1000 TO 2000
VERY STIFF	2000 TO 4000
HARD	GREATER THAN 4000

DATUM

ELEVATIONS ARE BASED ON AN ASSUMED DATUM. TOP OF FIRE HYDRANT ON EAST SIDE OF INDIANA STREET 352 FEET SOUTH OF 26TH STREET = ELEVATION 100.0 FEET.

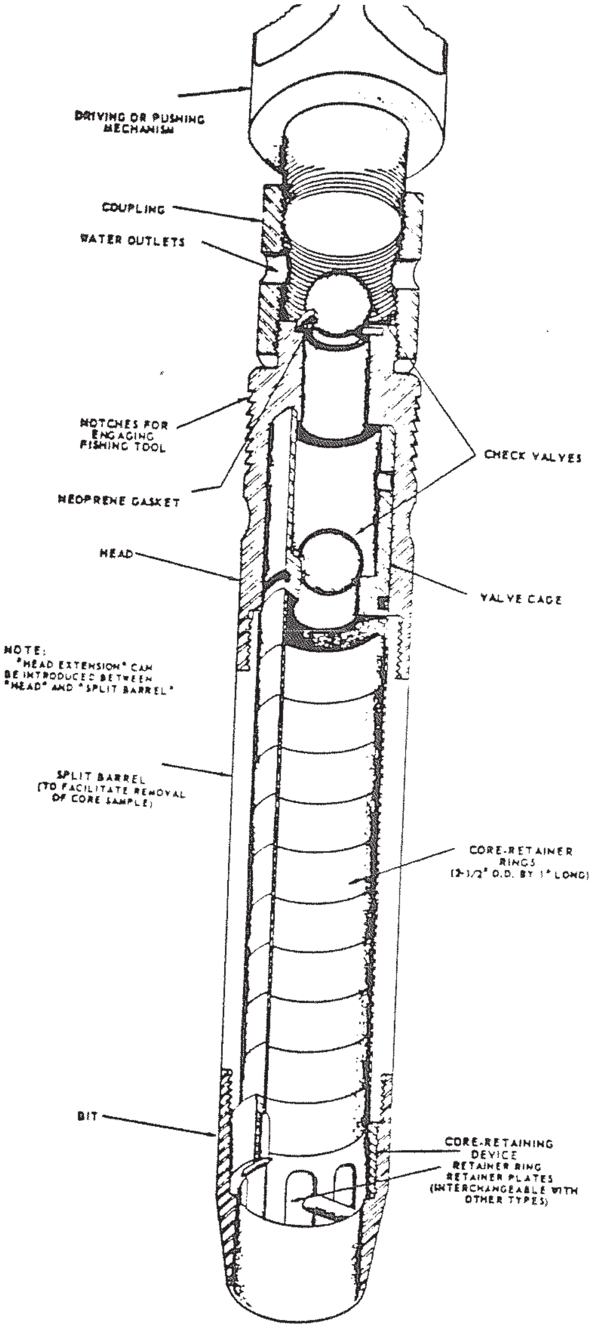
KEY TO LOG OF BORINGS

DAMES & MOORE

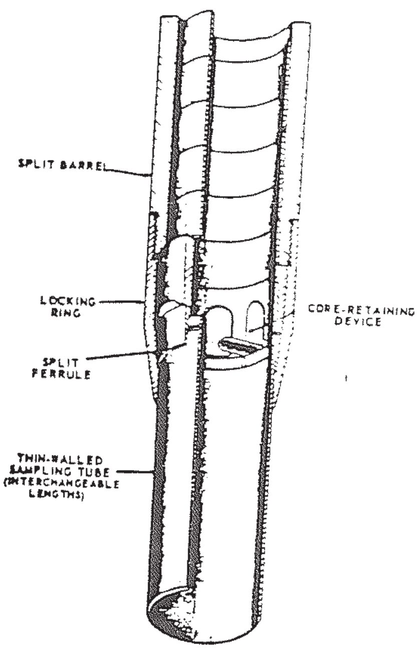
PLATE A-2

SOIL SAMPLER TYPE U

FOR SOILS DIFFICULT TO RETAIN IN SAMPLER



ALTERNATE ATTACHMENTS



417.9 (5-68)

DAMES & MOORE

Plate A-3

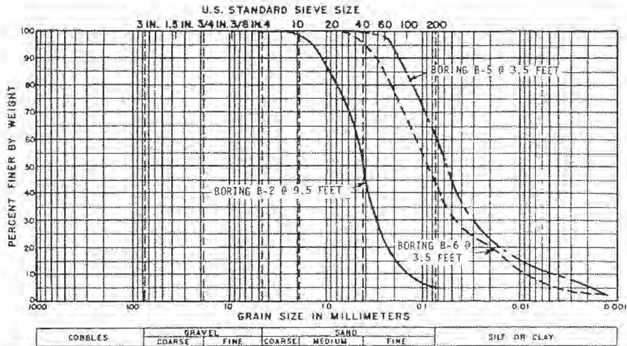
MAJOR DIVISIONS			GRAPH SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SAND AND SANDY SOILS	CLEAN SAND (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE				SP	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND-SILT MIXTURES
				SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE				CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS.

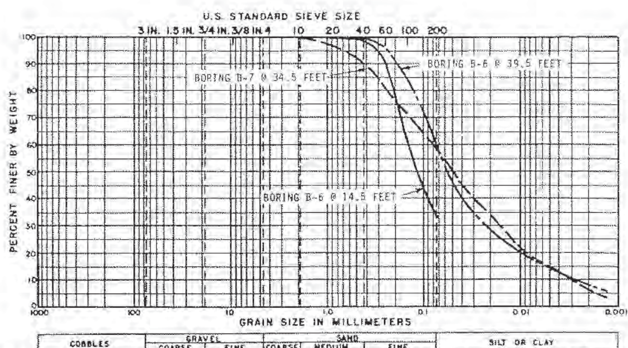
SOIL CLASSIFICATION CHART

UNIFIED SOIL CLASSIFICATION SYSTEM

DAMES & MOORE



BORING	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	
B-2	9.5 FEET	SP	FINE TO MEDIUM SAND					
B-5	3.5 FEET	ML	FINE SANDY SILT (NEAR SM)					
B-6	3.5 FEET	SM	SILTY FINE SAND					



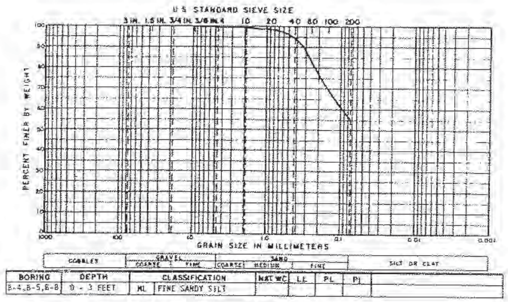
BORING	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	
—— B-6	14.5 FEET	SM	SILTY FINE SAND					
—·— B-6	39.5 FEET	ML	FINE SANDY SILT					
— — B-7	34.5 FEET	CL	SANDY CLAY					

GRADATION CURVES

DAMES & MOORE

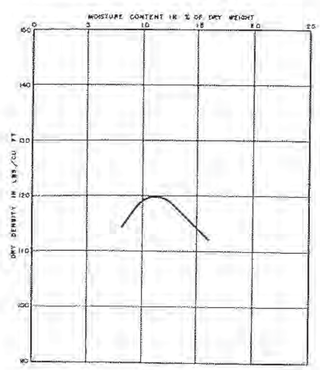
PLATE A-5

BULK SAMPLE NO. 1



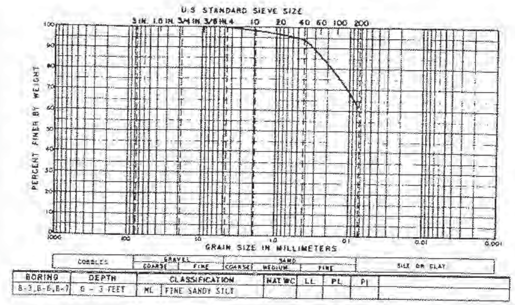
GRADATION CURVE

SAMPLE NO. 1 DEPTH 0 - 3' ELEVATION
SOIL DARK BROWN FINE SANDY SILT
LOCATION AREA OF BORINGS B-4, B-5 AND B-6
OPTIMUM MOISTURE CONTENT 11%
MAXIMUM DRY DENSITY 120 PCF
METHOD OF COMPACTION ASTM D 1557-78



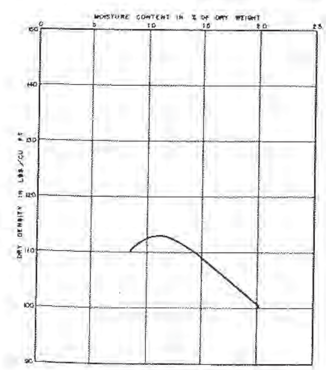
COMPACTION TEST DATA

BULK SAMPLE NO. 2



GRADATION CURVE

SAMPLE NO. 2 DEPTH 0 - 3' ELEVATION
SOIL DARK BROWN FINE SANDY SILT
LOCATION AREA OF BORINGS B-3, B-6 AND B-7
OPTIMUM MOISTURE CONTENT 11%
MAXIMUM DRY DENSITY 113 PCF
METHOD OF COMPACTION ASTM D 1557-78



COMPACTION TEST DATA

COMPACTED MOISTURE (PERCENT)	DRY DENSITY (LB./CU. FT.)	PERCENT COMPACTION	CBR
11.6	102	90	7
10.4	108	95	19
10.1	113	100	22

CBR TEST DATA (BULK SAMPLE NO. 2)

PAVEMENT DESIGN TESTS

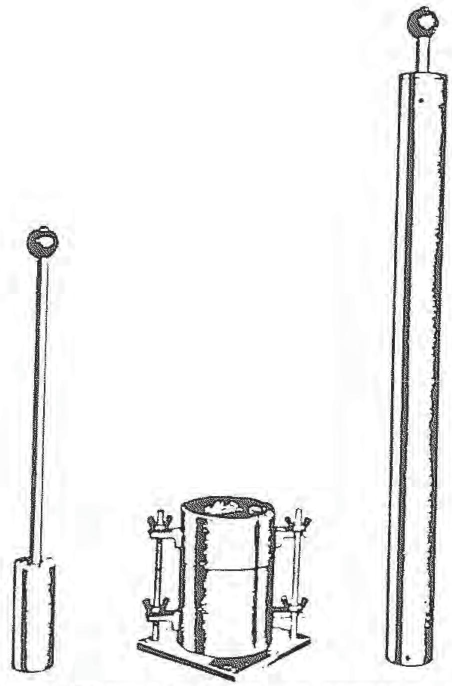
DAMES & MOORE

PLATE A-6

Method Of Performing Compaction Tests
(STANDARD AND MODIFIED A.A.S.H.O. METHODS)

IT HAS BEEN ESTABLISHED THAT WHEN COMPACTING EFFORT IS HELD CONSTANT, THE DENSITY OF A ROLLED EARTH FILL INCREASES WITH ADDED MOISTURE UNTIL A MAXIMUM DRY DENSITY IS OBTAINED AT A MOISTURE CONTENT TERMED THE "OPTIMUM MOISTURE CONTENT," AFTER WHICH THE DRY DENSITY DECREASES. THE COMPACTION CURVE SHOWING THE RELATIONSHIP BETWEEN DENSITY AND MOISTURE CONTENT FOR A SPECIFIC COMPACTING EFFORT IS DETERMINED BY EXPERIMENTAL METHODS. TWO COMMONLY USED METHODS ARE DESCRIBED IN THE FOLLOWING PARAGRAPHS.

FOR THE "STANDARD A.A.S.H.O." (A.S.T.M. D698-66T & A.A.S.H.O. T99-61) METHOD OF COMPACTION A PORTION OF THE SOIL SAMPLE PASSING THE NO. 4 SIEVE IS COMPACTED AT A SPECIFIC MOISTURE CONTENT IN THREE EQUAL LAYERS IN A STANDARD COMPACTION CYLINDER HAVING A VOLUME OF 1/30 CUBIC FOOT, USING TWENTY-FIVE 12-INCH BLOWS OF A STANDARD 5-1/2 POUND RAMMER TO COMPACT EACH LAYER.



SOME APPARATUS FOR PERFORMING COMPACTION TESTS
Shows, from left to right, 5-1/2 pound rammer (sleeve controlling 12" height of drop removed), 1/30 cubic-foot cylinder with removable collar and base plate, and 10 pound rammer within sleeve.

IN THE "MODIFIED A.A.S.H.O." (A.S.T.M. D-1557-66T & A.A.S.H.O. T 180-61) METHOD OF COMPACTION A PORTION OF THE SOIL SAMPLE PASSING THE NO. 4 SIEVE IS COMPACTED AT A SPECIFIC MOISTURE CONTENT IN FIVE EQUAL LAYERS IN A STANDARD COMPACTION CYLINDER HAVING A VOLUME OF 1/30 CUBIC FOOT, USING TWENTY-FIVE 18-INCH BLOWS OF A 10-POUND RAMMER TO COMPACT EACH LAYER. SEVERAL VARIATIONS OF THESE COMPACTION TESTING METHODS ARE OFTEN USED AND THESE ARE DESCRIBED IN A.A.S.H.O. & A.S.T.M. SPECIFICATIONS.

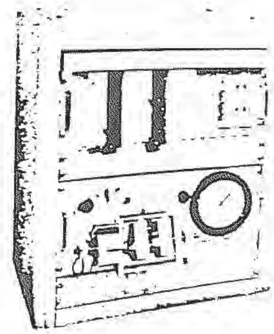
FOR BOTH METHODS, THE WET DENSITY OF THE COMPACTED SAMPLE IS DETERMINED BY WEIGHING THE KNOWN VOLUME OF SOIL; THE MOISTURE CONTENT, BY MEASURING THE LOSS OF WEIGHT OF A PORTION OF THE SAMPLE WHEN OVEN DRIED; AND THE DRY DENSITY, BY COMPUTING IT FROM THE WET DENSITY AND MOISTURE CONTENT. A SERIES OF SUCH COMPACTIONS IS PERFORMED AT INCREASING MOISTURE CONTENTS UNTIL A SUFFICIENT NUMBER OF POINTS DEFINING THE MOISTURE-DENSITY RELATIONSHIP HAVE BEEN OBTAINED TO PERMIT THE PLOTTING OF THE COMPACTION CURVE. THE MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT FOR THE PARTICULAR COMPACTING EFFORT ARE DETERMINED FROM THE COMPACTION CURVE.

417.7 (Rev. 4-68)

DAMES & MOORE
Plate A-8

Method Of Performing Direct Shear and Friction Tests

Direct shear tests are performed to determine the shearing strengths of soils. Friction tests are performed to determine the frictional resistances between soils and various other materials such as wood, steel, or concrete. The tests are performed in the laboratory to simulate anticipated field conditions.



DIRECT SHEAR APPARATUS WITH ELECTRONIC RECORDER

Each sample is tested within three brass rings, two and one-half inches in diameter and one inch in length. Undisturbed samples of in-place soils are tested in rings taken from the sampling device in which the samples were obtained. Loose samples of soils to be used in constructing earth fills are compacted in rings to predetermined conditions and tested.

Direct Shear Tests

A three-inch length of the sample is tested in direct double shear. A constant pressure, appropriate to the conditions of the problem for which the test is being performed, is applied normal to the ends of the sample through porous stones. A shearing failure of the sample is caused by moving the center ring in a direction perpendicular to the axis of the sample. Transverse movement of the outer rings is prevented.

The shearing failure may be accomplished by applying to the center ring either a constant rate of load, a constant rate of deflection, or increments of load or deflection. In each case, the shearing load and the deflections in both the axial and transverse directions are recorded and plotted. The shearing strength of the soil is determined from the resulting load-deflection curves.

Friction Tests

In order to determine the frictional resistance between soil and the surfaces of various materials, the center ring of soil in the direct shear test is replaced by a disk of the material to be tested. The test is then performed in the same manner as the direct shear test by forcing the disk of material from the soil surfaces.

417.1 (Rev. 8–74)

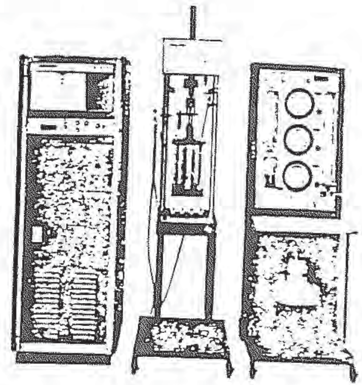
DAMES & MOORE

Plate A-9

Methods of Performing Unconfined Compression and Triaxial Compression Tests

The shearing strengths of soils are determined from the results of unconfined compression and triaxial compression tests. In triaxial compression tests the test method and the magnitude of the confining pressure are chosen to simulate anticipated field conditions.

Unconfined compression and triaxial compression tests are performed on undisturbed or remolded samples of soil approximately six inches in length and two and one-half inches in diameter. The tests are run either strain-controlled or stress-controlled. In a strain-controlled test the sample is subjected to a constant rate of deflection and the resulting stresses are recorded. In a stress-controlled test the sample is subjected to equal increments of load with each increment being maintained until an equilibrium condition with respect to strain is achieved.



TRIAXIAL COMPRESSION TEST UNIT

Yield, peak, or ultimate stresses are determined from the stress-strain plot for each sample and the principal stresses are evaluated. The principal stresses are plotted on a Mohr's circle diagram to determine the shearing strength of the soil type being tested.

Unconfined compression tests can be performed only on samples with sufficient cohesion so that the soil will stand as an unsupported cylinder. These tests may be run at natural moisture content or on artificially saturated soils.

In a triaxial compression test the sample is encased in a rubber membrane, placed in a test chamber, and subjected to a confining pressure throughout the duration of the test. Normally, this confining pressure is maintained at a constant level, although for special tests it may be varied in relation to the measured stresses. Triaxial compression tests may be run on soils at field moisture content or on artificially saturated samples. The tests are performed in one of the following ways:

<u>Unconsolidated-Undrained</u>: The confining pressure is imposed on the sample at the start of the test. No drainage is permitted and the stresses which are measured represent the sum of the intergranular stresses and pore water pressures.

<u>Consolidated-Undrained</u>: The sample is allowed to consolidate fully under the applied confining pressure prior to the start of the test. The volume change is determined by measuring the water and/or air expelled during consolidation. No drainage is permitted during the test and the stresses which are measured are the same as for the unconsolidated-undrained test.

<u>Drained</u>: The intergranular stresses in a sample may be measured by performing a drained, or slow, test. In this test the sample is fully saturated and consolidated prior to the start of the test. During the test, drainage is permitted and the test is performed at a slow enough rate to prevent the buildup of pore water pressures. The resulting stresses which are measured represent only the intergranular stresses. These tests are usually performed on samples of generally non-cohesive soils, although the test procedure is applicable to cohesive soils if a sufficiently slow test rate is used.

An alternate means of obtaining the data resulting from the drained test is to perform an undrained test in which special equipment is used to measure the pore water pressures. The differences between the total stresses and the pore water pressures measured are the intergranular stresses.

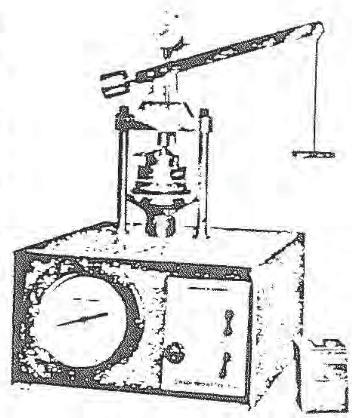
417.14 (1-75)

Plate A-10

Method Of Performing Consolidation Tests

Consolidation tests are performed to evaluate the volume changes of soils subjected to increased loads. Time-consolidation and pressure-consolidation curves may be plotted from the data obtained in the tests. Engineering analyses based on these curves permit estimates to be made of the probable magnitude and rate of settlement of the tested soils under applied loads.

Each sample is tested within brass rings two and one-half inches in diameter and one inch in length. Undisturbed samples of in-place soils are tested in rings taken from the sampling device in which the samples were obtained. Loose samples of soils to be used in constructing earth fills are compacted in rings to predetermined conditions and tested.

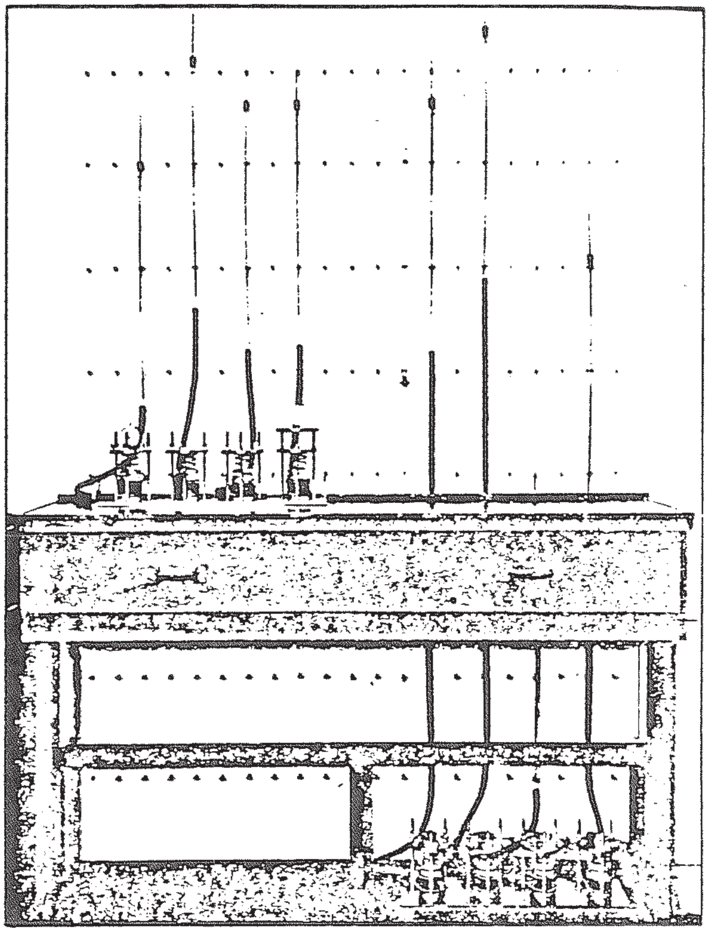


DEAD LOAD-PNEUMATIC CONSOLIDOMETER

In testing, the sample is rigidly confined laterally by the brass ring. Axial loads are transmitted to the ends of the sample by porous disks. The disks allow drainage of the loaded sample. The axial compression or expansion of the sample is measured by a micrometer dial indicator at appropriate time intervals after each load increment is applied. Each load is ordinarily twice the preceding load. The increments are selected to obtain consolidation data representing the field loading conditions for which the test is being performed. Each load increment is allowed to act over an interval of time dependent on the type and extent of the soil in the field.

FORM NO. 417.3 (Rev. 1-75)

Plate A-11



APPARATUS FOR PERFORMING PERCOLATIONS TESTS
Shows tests in progress on eight samples simultaneously.

The quantity and the velocity of flow of water which will escape through an earth structure or percolate through soil are dependent upon the permeability of the earth structure or soil. The permeability of soil has often been calculated by empirical formulas but is best determined by laboratory tests, especially in the case of compacted soils.

A one-inch length of the core sample is sealed in the percolation apparatus, placed under a confining load, or surcharge pressure, and subjected to the pressure of a known head of water. The percolation rate is computed from the measurements of the volume of water which flows through the sample in a series of time intervals. These rates are usually expressed as the velocity of flow in feet per year under a hydraulic gradient of one and at a temperature of 20 degrees Centigrade. The rate so expressed may be adjusted for any set of conditions involving the same soil by employing established physical laws. Generally, the percolation rate varies over a wide range at the beginning of the test and gradually approaches equilibrium as the test progresses.

During the performance of the test, continuous readings of the deflection of the sample are taken by means of micrometer dial gauges. The amount of compression or expansion, expressed as a percentage of the original length of the sample, is a valuable indication of the compression of the soil which will occur under the action of load or the expansion of the soil as saturation takes place.

Gould Inc., Metals Division
2700 South Indiana Street, Los Angeles nia 90023
Telephone (213) 262-1101

GOULD

Hazardous Materials Management Section
OCT 03 1980
LOS ANGELES

September 30, 1980

Mr. Miller E. Chambers
Associate Waste Management Engineer
Department of Health Services
Hazardous Materials Management Section
1449 West Temple Street
Los Angeles, CA 90026

Dear Mr. Chambers:

This is to advise that in the excavation of our north yard, we removed approximately 23940 cubic yards of dirt and disposed of the material at a dump site operated by BKK Corp., 2550 237th Street, Torrance, CA, 90505.

Sincerely,

Philip M Freeman

Philip M. Freeman
Plant Manager

PMF:kh

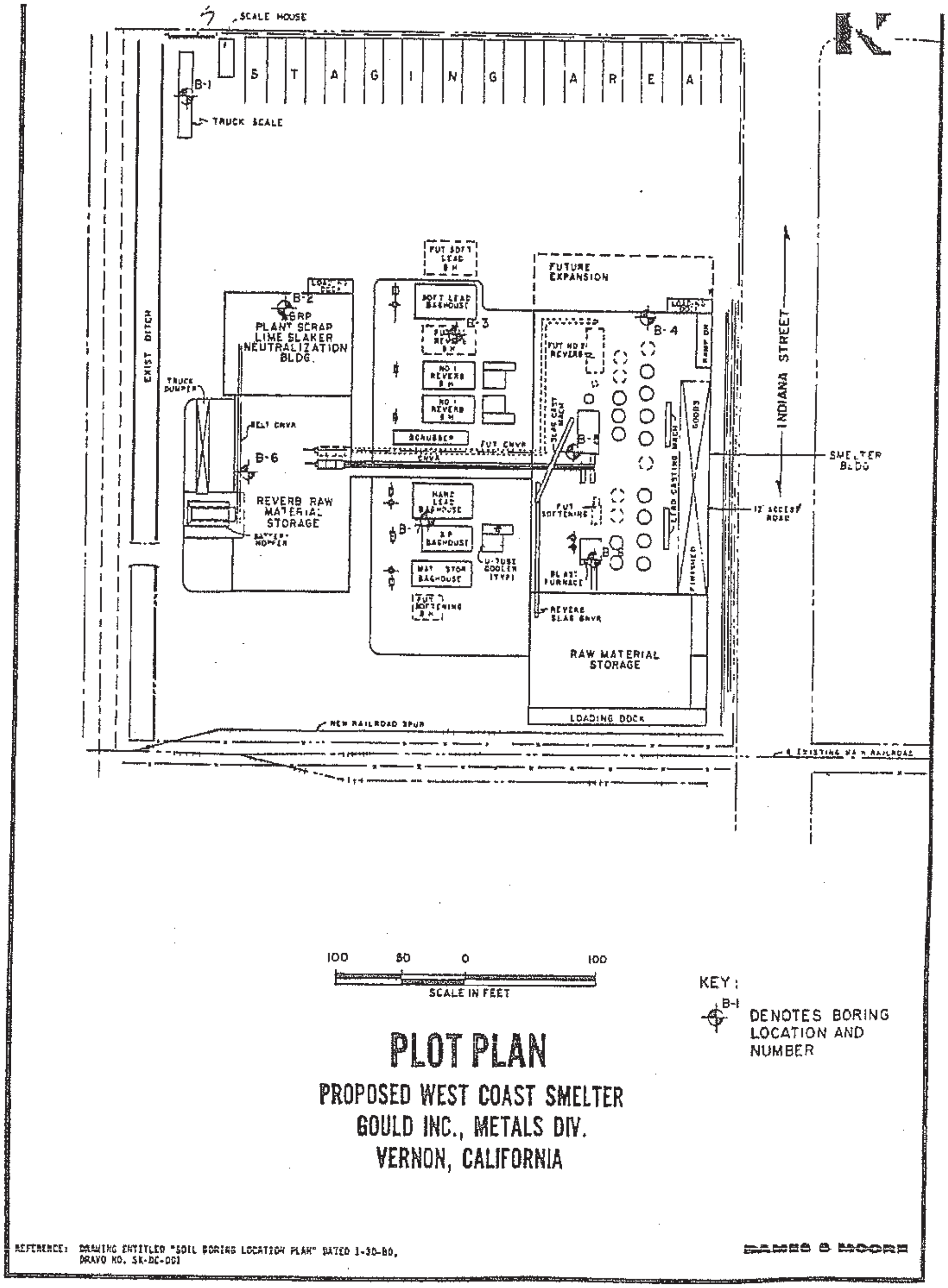
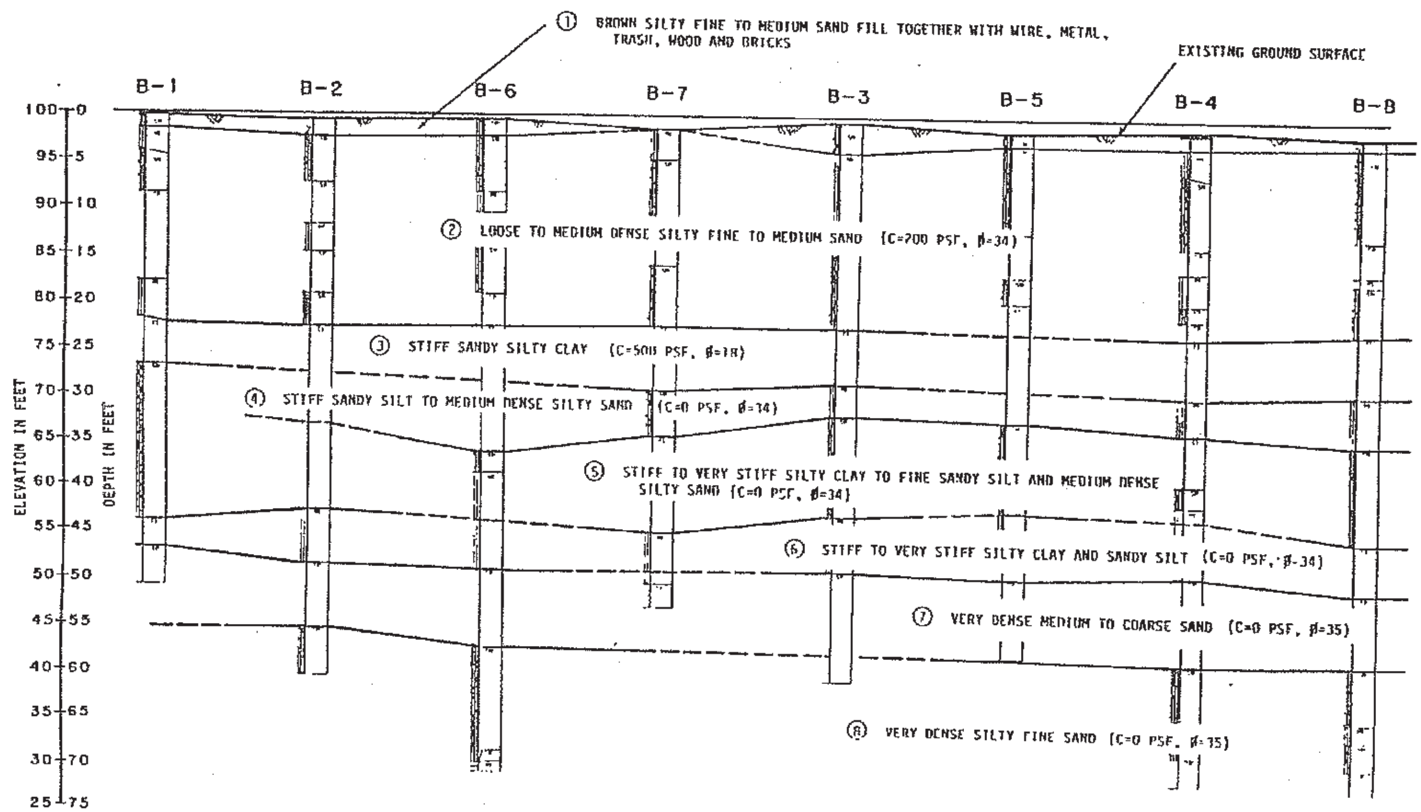

SCALE HOUSE
S T A G I N G A R E A
B-1
TRUCK SCALE
EXIST DITCH
INDIANA STREET
FUTURE EXPANSION
B-2
PLANT SCRAP
LIME SLAKER
NEUTRALIZATION BLDG.
B-3
B-4
B-5
B-6
B-7
B-8
TRUCK DUMPER
BELT CNVR
REVERB RAW MATERIAL STORAGE
BATTERY HOPPER
SOFT LEAD BAGHOUSE
NO 1 REVERB B H
SCRUBBER
FUT CNVR
HARD LEAD BAGHOUSE
B.F. BAGHOUSE
MAT STOR BAGHOUSE
U-TUBE COOLER (TYP)
FUT SOFTENING B H
FUT SOFTENING
BLAST FURNACE
REVERB SLAG CNVR
LEAD CASTING MACH
FINISHED GOODS
SMELTER BLDG
12' ACCESS ROAD
RAW MATERIAL STORAGE
LOADING DOCK
NEW RAILROAD SPUR
EXISTING RAILROAD
100 50 0 100
SCALE IN FEET
KEY:
B-1
DENOTES BORING LOCATION AND NUMBER
PLOT PLAN
PROPOSED WEST COAST SMELTER
GOULD INC., METALS DIV.
VERNON, CALIFORNIA
REFERENCE: DRAWING ENTITLED "SOIL BORING LOCATION PLAN" DATED 1-30-80, DRAVO NO. SK-DC-001
DAMES & MOORE

PLATE 2



GENERALIZED SUBSOIL PROFILE

PLATE 3

GOULD

NORTH LOT SOIL DISPOSAL

* The following is the soil sample analyses of Gould's North lot, located at 26th Street and Indiana Street.

*To 24 inches

Lead	Min.	=	.1%	1000 PPM
	Ave.	=	2.0%	20,000 PPM
	Max.	=	33.7%	337,000 PPM
Tin	Min.	=	Trace	
	Ave.	=	.04%	
	Max.	=	.49%	
Cadmium	Ave. less than .001%			
Arsenic	Min. less than .01%			
	Ave.	=	.02%	
	Max.	=	.17%	(1700 - PPM)
Antimony	Min.	=	.01%	
	Ave.	=	.11%	
	Max.	=	.58%	(5800 - PPM)

Note: The above was prepared by Ken Ford

ANALYSES DONE AT GOULD PLANT

8 SAMPLES TAKEN.

1 SAMPLE @ 40% LEAD - EXCAVATED AREA, FED TO FURNACE.

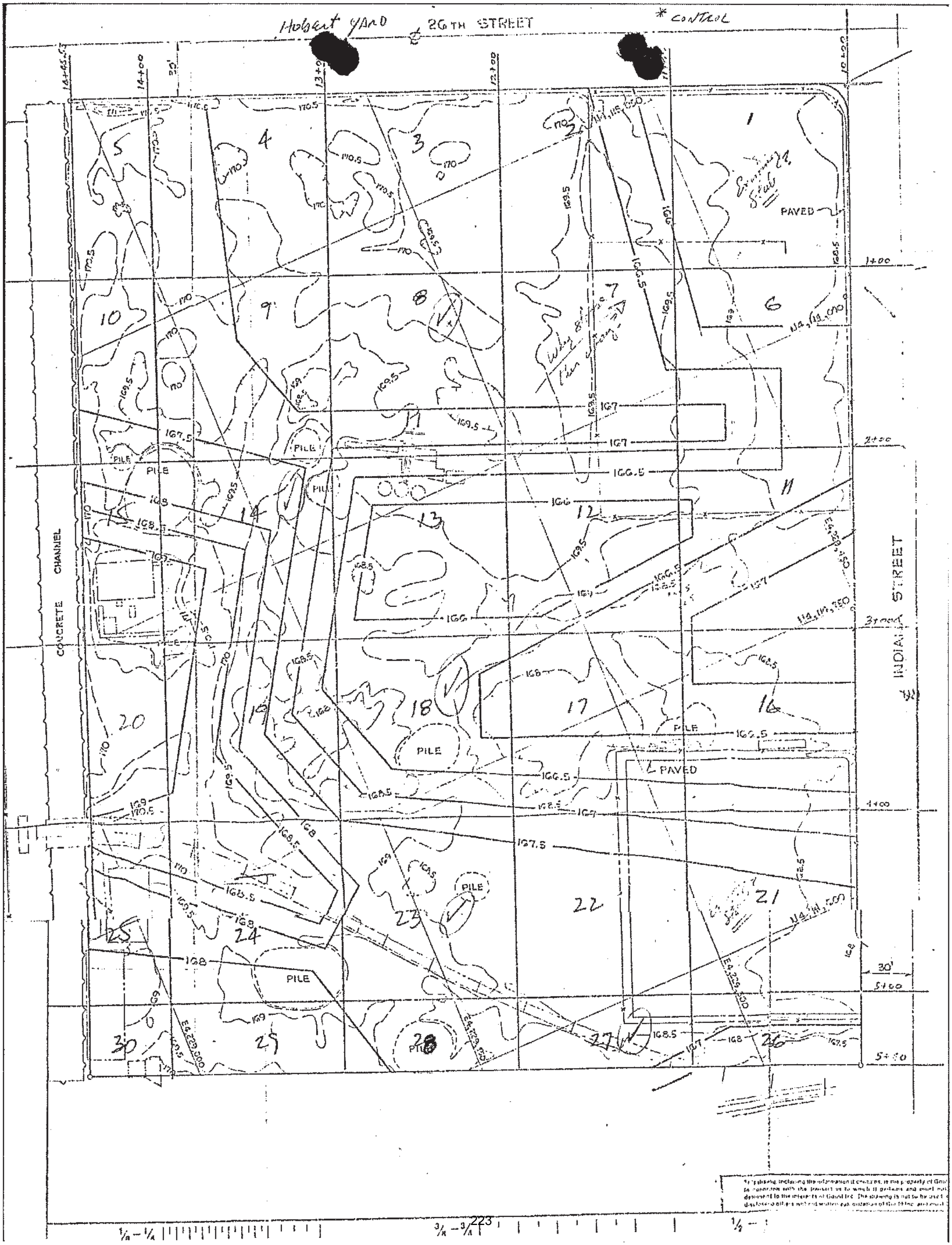
6/26/80

Soil Samples

Depth	Bore #		Pb	Sn	Cd	Sb	As
		1	41	Tr	.001-	05-	.01-
1A	B2	2	17.41	.18	.001-	.44	.06
1A	B4	3	1.12	.12	.001-	.25	.01-
1B	B8	4	.41	Tr	.001-	.05-	.01-
2A	B8	5	.20	Tr	.001-	.30	.01-
1B	B2	6	.41	.11	.001-	.05-	.01-
2A	B4	7	.10	Tr	.001-	.05-	.01-
1C	B2	8	.20	Tr	.001-	.05-	.01-
1A	B7	9	.10	Tr	.001-	.10	.01-
1B	B7	10	.20	Tr	.001-	.05-	.01-
2A	B7	11	4.68	.18	.001-	.32	.068
2B	B7	12	.20	.11	.001-	.05-	.01-
3A	B1	13	.10	.10	.001-	.10	.01-
2A	B1	14	.10	Tr	.001-	.05-	.01-
1A	B1	15	33.70	.49	.001-	.58	.17
1B	B3	16	45.91	.18	.001-	.51	.077
2A	B3	17	33.19	.25	.001-	.52	.097
2B	B3	18	27.59	.31	.001-	.48	.093
1A	B3	19	39.70	.25	.001-	.53	.12
1A	B5	20	20.97	.34	.001-	.45	.08
1B	B6	21	.10	.10	.001-	.05-	.01-
1A	B6	22	6.01	.12	.001-	.40	.071
2A	B6	23	.10	Tr	.001-	.05-	.01-

Depth	Bore #		Pb	Sn	Cd	Sb	As
1B	B5	24	.10	Tr	.001-	.05-	.01-
1B	B4	25	.31	Tr	.001-	.05-	.01-
2A	B5	26	.20	Tr	.001-	.05-	.01-

#	Depth	
B1	1A	Surface
	2A	12"
	3A	24"



Hobert YARD
26TH STREET
* CONTROL
CONCRETE CHANNEL
INDIANA STREET
PAVED
PILE
14+45.53
14+00
13+00
12+00
10+00
1+00
2+00
3+00
4+00
5+00
5+50
30'
N4,118,050
N4,118,010
N4,118,750
N4,118,500
E4,229,150
E4,229,200
E4,229,000
170.5
170
169.5
169
168.5
168
167.5
167
166.5
166

cer 'ied testing laborato s, inc.

2905 East Century Blvd. • South Gate, Calif. 90280 • (213) 564-2041

LABORATORY NO. ES 6456 REPORTED 8- 4-80

CLIENT GOULD, INC.
2700 S. Indiana Street
Los Angeles, California 90023

Sample Surface soil

Marks As shown below

Based on sample As Received

Results:

LOCATION	LEAD (mg/kg)	ARSENIC (mg/kg)	LOCATION	LEAD (mg/kg)	ARSENIC (mg/kg)
1	18.7	<5	16	80	7.4
2	5,170	19.8	17	8,000	171
3	25.2	<5	18	92	<5
4	33.2	<5	19	1,424	36
5	170	12.7	20	80	6.3
6	44.9	5.0	21	84	<5
7	16.2	<5	22	367	13.5
8	39,100	112	23	143	<5
9	63,700	470	24	873	<5
10	12,900	126	25	114,300	990
11	388	10.8	26	198	<5
12	68	6.2	27	2,139	7.7
13	9,700	8.2	28	2,050	9.0
14	242	148	29	1,214	17.9
15	33,000	229	30	1,110	7.9
			Control	680	5.6

Above samples were taken from the construction area north of Gould, Inc. at 2700 S. Indiana Street, Los Angeles, California. Grid sampling points spaced at 100 foot intervals and samples taken 6 inches below the surface.

Method Samples were digested in a mixture of nitric and hydrofluoric acids using Parr Teflon acid digestion bomb at a temperature of 140°C for 12 hours. The resulting acid solutions were analyzed with a Perkin-Elmer Model 460 atomic absorption spectrophotometer. Samples in the range below 50 mg/kg Pb were analyzed with the aid of the HGA graphite furnace accessory. Analysis for arsenic was conducted with Perkin-Elmer Model 460 AA spectrophotometer utilizing HGA graphite furnace accessory and Nickel Nitrate matrix modification.

Respectfully submitted,

Stuart E. Salot, Ph.D.

PRIORITY ☒
(explain) HIGH — MUST HAVE Pb, As RESULTS BY EARLY NEXT WEEK

SCL ~~HML~~ No. 625 to 630

HAZARDOUS MATERIALS SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

COLLECTOR H. SNEH DATE SAMPLED 7/30/80 TIME 1430–1700 HOURS

LOCATION OF SAMPLING:

NAME GOULD METALS DIV. – NORTH YARD TEL NO. ______

ADDRESS VERNON (number, street, state, zip)

SCL ~~HML~~ NO. (Lab only)	COLLECTOR'S SAMPLE NO.	TYPE OF SAMPLE*	FIELD INFORMATION**
625	HSGM-8	SOIL	ALL SAMPLES COLLECTED @
626	HSGM-14	SOIL	6" DEPTH (EXCEPT "CONTROL"
627	HSGM-18	SOIL	SAMPLE – COLLECTED @ 1"-3"
628	HSGM-23	SOIL	DEPTH)
629	HSGM-27	SOIL	
630	HSGM-CONTROL	SOIL	

ANALYSIS REQUESTED: Pb, As, Sb, Sn

PRIORITY TO Pb, As DETERMINATIONS.

NOTE: KEEP SAMPLES FOR POSSIBLE FURTHER ANALYSES

CHAIN OF CUSTODY:

	signature	title	inclusive dates
1.	H. Sneh	ASSOC. WASTE MGMT ENGR.	7/30/80 – 8/1/80
2.			–
3.			–
4.			–

SPECIAL REMARKS SAMPLES SUBMITTED WERE SPLIT FROM A SET OF 31
(e.g. duplicate sample given to company, etc.)
SAMPLES COLLECTED BY ROBT. DEAL, CTL LABORATORY.

PART II: LABORATORY SECTION

RECEIVED BY Monica Lgac TITLE P.H. Chemist DATE Aug. 1, 1980

SAMPLE ALLOCATION: ☐ HML ☐ SCBL ☐ LBL ☐ OTHER ______ DATE ______

ANALYSIS REQUIRED ______

*Indicate whether sample is sludge, soil, etc.; **Use back of page for additional info

CALIFORNIA DEPT. OF HEALTH SERVICES-HAZARDOUS MATERIALS LABORATORY--June 1979
Revised April 1980 ERD

FILE: GOULD METALS

SOUTHERN CALIFORNIA LABORATORY SECTION
HAZARDOUS MATERIALS MANAGEMENT UNIT

LABORATORY REPORT

SCL NO.: 625-630

DATE OF REPORT: 10/9/80

TO: H Snell

SAMPLING DATE: 7/30/80

SAMPLING NO: HSGM-8,14,18,23,27-Control

DATE RECEIVED: 8/1/80

SAMPLE LOCATION: Gould Metals Div North yard Vernon

ANALYTICAL PROCEDURES USED: Pb: HNO_3 digestion, AA
As: $H_2SO_4 + HNO_3$ digestion - silver diethyldithiocarbamate colorimetric determination Sb and Sn - same digestion as for As, determined by AA in flame mode.

REFERENCE: Perkin Elmer AA Manual, Standard Methods 14th Ed pg. 283

ANALYSIS RESULTS:

Calculated on dry basis

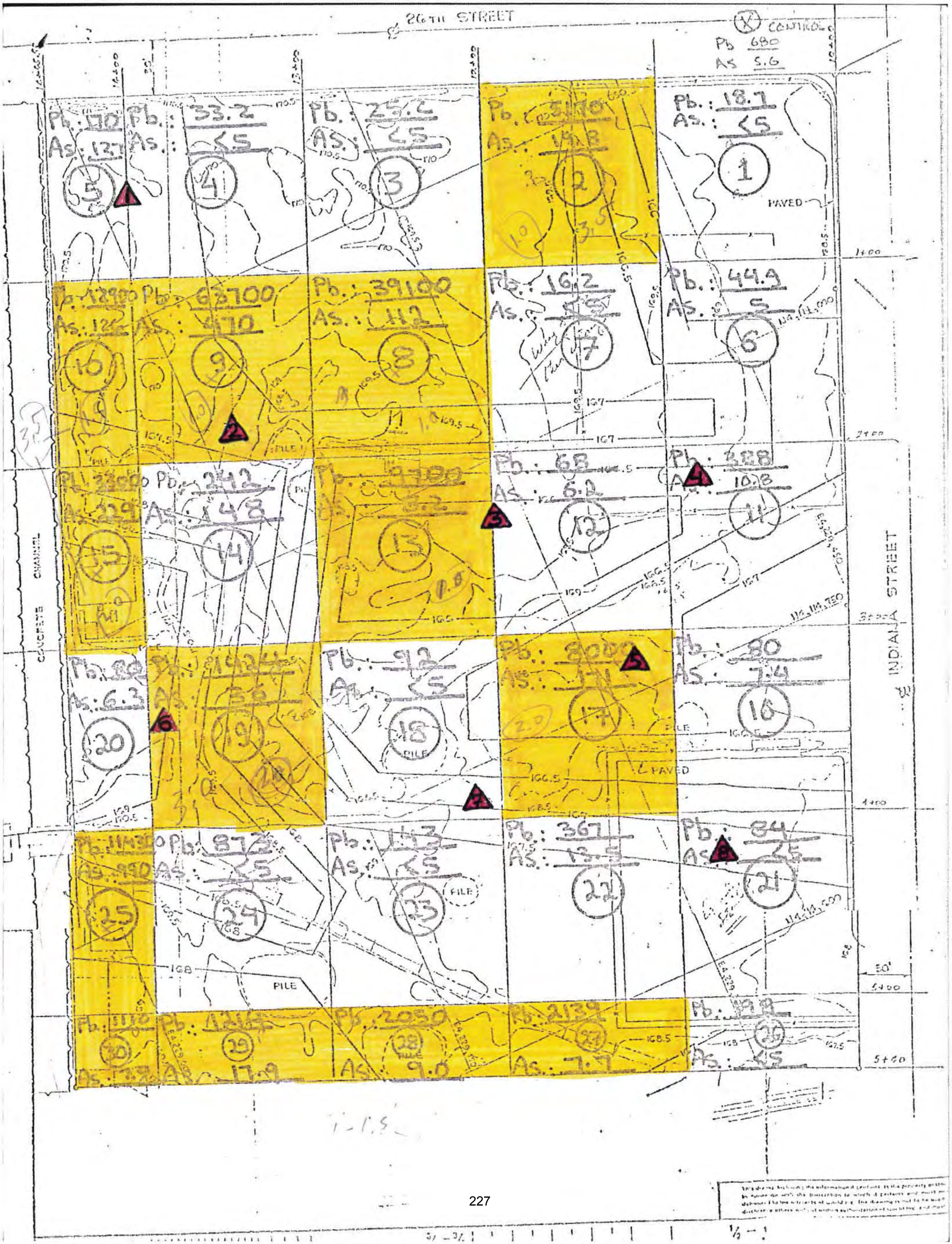
SCL No.	Sampling No.	Pb ppm	As ppm	Sb ppm	Sn ppm	
625	HSGM-8	50,000	79	380	520	
626	HSGM-14	38	140	130	71	
627	HSGM-18	56	1.0	81	60	
628	HSGM-23	730	1.1	51	100	
629	HSGM-27	5,400	22	220	140	
630	HSGM-Control	1,200	11	69	51	

ANALYSTS' SIGNATURES:

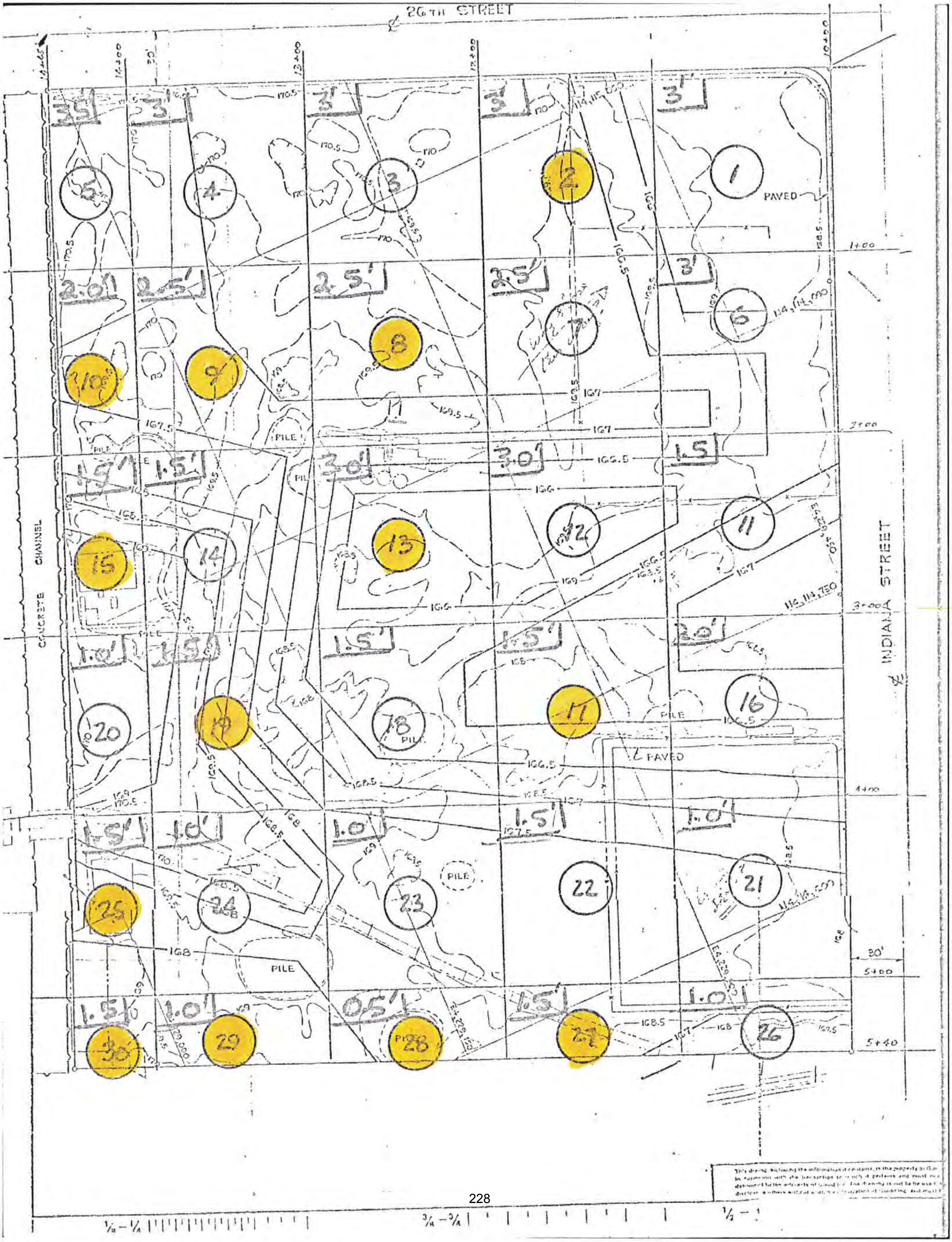
Mary W Claridge 10/9/80
date

Monica D. Ligar 8-28-80
date

Copies to:
Paul de Vera

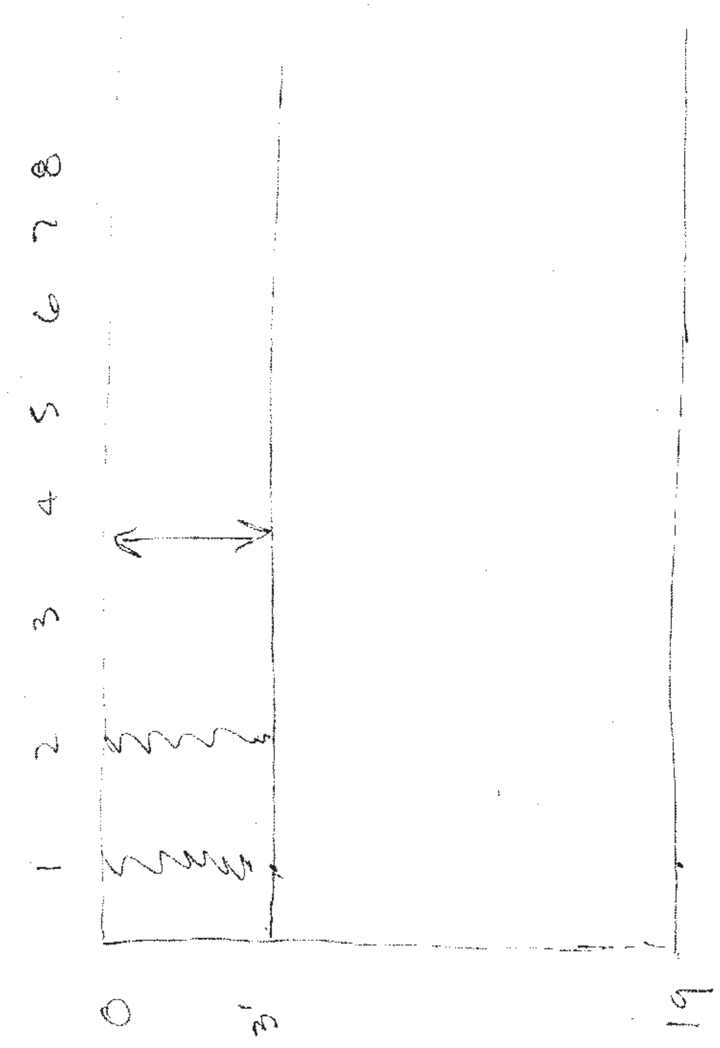


26TH STREET
CONTROL
Pb 680
As 5.6
Pb.: 18.7
As.: <5
Pb.: 25.2
As.: <5
Pb.: 33.2
As.: <5
Pb.: 44.9
As.: 5
Pb.: 16.2
As.: <5
Pb.: 39100
As.: 112
Pb.: 63700
Pb.: 68
As.: 6.2
Pb.: 242
Pb.: 80
As.: 7.4
Pb.: 92
As.: <5
As.: 6.3
Pb.: 367
As.: 13.5
Pb.: 873
As.: <5
As.: <5
As.: 990
Pb.: 2050
As.: 9.0
Pb.: 2139
As.: <5
PAVED
PILE
INDIANA STREET
CONCRETE CHANNEL


26TH STREET
INDIANA STREET
CONCRETE CHANNEL
PAVED
PILE
1+00
2+00
3+00
4+00
5+00
5+40
30'

AD & ARSENIC VALUES (P1)
VS. EXCAVATION DEPTH

# \ FT	LEAD 0.5	1.0	1.5	2.0	2.5 (3.5)	3.0	3.5		ARSENIC 0.5	1.0	1.5	2.0	2.5	3.0	3.5
1						18.7								<5.0	
2						5170								19.8	
3						25.2								<5.0	
4						33.2								<5.0	
5							170								12.7
6						44.9								5.0	
7					16.2								<5.0		
8					39100								112		
9					63700								470		
10				12900								126			
11			388								10.8				
12						68								6.2	
13						9700								8.2	
14			242								148				
15			32000								229				
16				80										7.4	
17			8000								171				
18			92								<5.0				
19			1424								36				
20			80								6.3				
21		84								<5.0					
22			367								13.5				
23		143								<5.0					
24		873								<5.0					
25			114300 ?								990				
26		198								<5.0					
27			2139								7.7				
28	2050								9.0						
29		1214								17.9					
30			1110								7.9				


1 2 3 4 5 6 7 8
0

PRIORITY ☒
(explain) NEEDED [illegible]
COMPLIANCE DETERMINATION

~~HML~~ SCL No. 631 to 632

HAZARDOUS MATERIALS SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

COLLECTOR H. SNEH DATE SAMPLED 8/7/80 TIME 1400 HOURS

LOCATION OF SAMPLING:

NAME GOULD METALS TEL NO. ______

ADDRESS Vernon
number street state zip

~~HML~~ SCL NO. (Lab only)	COLLECTOR'S SAMPLE NO.	TYPE OF SAMPLE*	FIELD INFORMATION**
631	HSGM-8-1	SOIL	@ 1' DEPTH
632	HSGM-9-1	SOIL	@ 1' DEPTH

ANALYSIS REQUESTED: Pb, As

CHAIN OF CUSTODY:

	signature	title	inclusive dates
1.	H. Sneh	ASSOC. WM ENGR.	8/7/80 - 8/12/80
2.			-
3.			-
4.			-

SPECIAL REMARKS ______
(e.g. duplicate sample given to company, etc.)

PART II: LABORATORY SECTION

RECEIVED BY Mary W Claridg TITLE PH Chemist DATE 8/12/80

SAMPLE ALLOCATION: ☐ HML ☐ SCBL ☐ LBL ☐ OTHER ______ DATE ______

ANALYSIS REQUIRED Pb, As on dry basis

*Indicate whether sample is sludge, soil, etc.; **Use back of page for additional info

CALIFORNIA DEPT. OF HEALTH SERVICES-HAZARDOUS MATERIALS LABORATORY--June 1979
Revised April 1980 ERD

SOUTHERN CALIFORNIA LABORATORY SECTION
HAZARDOUS MATERIALS MANAGEMENT UNIT

LABORATORY REPORT

SCL NO.: 631 to 632

DATE OF REPORT: 10/9/80

TO: H. Sneh

SAMPLING DATE: 8/7/80

SAMPLING NO: HSGM-8-1 & HSGM-9-1

DATE RECEIVED: 8/12/80

SAMPLE LOCATION: Gould Metals
Vernon

ANALYTICAL PROCEDURES USED: Pb: HNO3 digestion - AA analysis

REFERENCE: Perkin Elmer AA Manual

ANALYSIS RESULTS:

calculated on dry basis

SCL No.	Sampling No	Pb, ppm	As, ppm	Sb ppm	Sn ppm	
631	HSGM-8-1	9.2	1.6	65	<50	
632	HSGM-9-1	43	1.6	70	<60	

ANALYSTS' SIGNATURES:

Mary W Claridge 10/9/80
date

Morgan D. Tegai 8/28/80
date

Copies to:

CTL

certified testing laboratories, inc.

[illegible]

LABORATORY NO. ES 6457

REPORTED 8-11-80

CLIENT GOULD, INC.
2700 S. Indiana Street
Los Angeles, California 90023

SAMPLED

RECEIVED 8- 7-80

SAMPLE Soil

MARKS See Below

BASED ON SAMPLE As Sampled

Results:

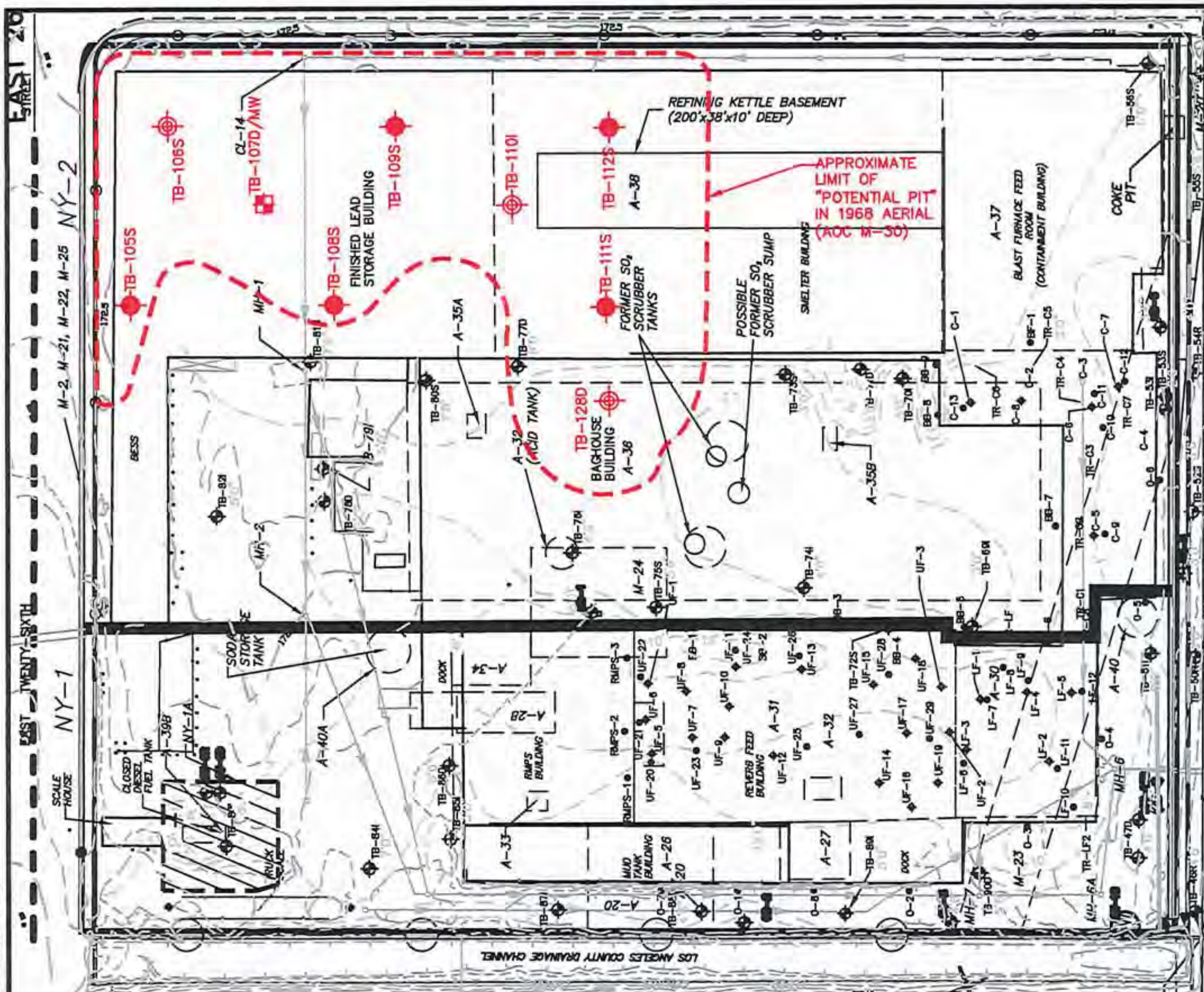
LOCATION	DEPTH(feet)	LEAD CONTENT(mg/kg)
# 8	1	<20
# 9	1	70
# 15	2	190
# 25	2	20

Respectfully submitted,

CERTIFIED TESTING LABORATORIES, INC.

Stuart E. Salot, Ph.D.

This report applies only to the sample, or samples, investigated and is not necessarily indicative of the quality or condition of apparently identical or similar products. As a mutual protection to clients, the public and these Laboratories, this report is submitted and accepted for the exclusive use of the client to whom it is addressed and upon the condition that it is not to be used, in whole or in part, in any advertising or publicity matter without prior written authorization from these Laboratories.



LEGEND:

- TB-01 SOIL BORING COMPREHENSIVE RFI: JAN. 2014 – SEPT. 2015
- HSA-01 SOIL BORING PHASE 2 AND 3 RFI –2008 AND 2009
- PW-1 GROUND WATER MONITORING WELL
- MW-1 GROUND WATER MONITORING WELL RFI
- RMPS-1 CONTAINMENT BUILDING SOIL BORING – RMPS AREA 2015
- LF-1 CONTAINMENT BUILDING SOIL BORING – LOWER FEED ROOM 2015
- UF-1 CONTAINMENT BUILDING SOIL BORING – UPPER FEED ROOM 2015
- BB-1 CONTAINMENT BUILDING SOIL BORING – BAGHOUSE BUILDING 2015
- O-1 CONTAINMENT BUILDING SOIL BORING – OUTSIDE 2015
- C-1 CONTAINMENT BUILDING SOIL BORING – CORRIDOR 2015
- VP-1 VAPOR PROBE COMPREHENSIVE RFI – JAN. 2014– SEPT.2015
- CB-1 CONTAINMENT BUILDING WELL 2015
- BF-1 CONTAINMENT BUILDING SOIL BORING – BLAST FEED 2015
- CONTOUR MAJOR
- CONTOUR MINOR
- PROPERTY LINE
- EXISTING WALL
- EXISTING FENCE
- WEST YARD-1
- WY-1A WEST YARD-1A
- APPROXIMATE LIMIT OF SWMU/AOC (WEST YARD-1)
- WEST YARD-2
- WY-2A WEST YARD-2A
- APPROXIMATE LIMIT OF SWMU/AOC (WEST YARD-2)
- SOUTH YARD-1
- APPROXIMATE LIMIT OF SWMU/AOC (SOUTH YARD-1)
- SOUTH YARD-2
- SY-2A SOUTH YARD-2A
- APPROXIMATE LIMIT OF SWMU/AOC (SOUTH YARD-2)
- SOUTH YARD-3
- APPROXIMATE LIMIT OF SWMU/AOC (SOUTH YARD-3)
- NORTH YARD-1
- NY-1A NORTH YARD-1A
- APPROXIMATE LIMIT OF SWMU/AOCT (NORTH YARD-1)
- NORTH YARD-2
- APPROXIMATE LIMIT OF SWMU/AOC (NORTH YARD-2)
- BOTTOM OF FILL 4' BGS
- BOTTOM OF FILL 6' BGS
- BOTTOM OF FILL 8' BGS
- BOTTOM OF FILL 10' BGS
- BOTTOM OF FILL 15' BGS
- PROPOSED DATA GAP SOIL BORING WITH SOIL GAS
- PROPOSED DATA GAP SOIL BORING
- TB-107D/MW PROPOSED DATA GAP GW WELL

NOTES:

1. THE TOP OF GROUND SURFACE DEPICTED ON THESE CROSS-SECTIONS WAS DEVELOPED USING THE TOPOGRAPHIC SURVEY COMPLETED IN 2006. A REVIEW OF TOP OF CASING ELEVATIONS SHOT IN BOTH THE 2006 AND 2015 SURVEYS HAS IDENTIFIED AN AVERAGE DISCREPANCY OF 2.16 FEET. TO COMPENSATE FOR THE DISCREPANCY BETWEEN THE 2015 AND 2006 SURVEYS, THE GROUND SURFACE ELEVATIONS AND PHYSICAL FEATURES DEPICTED ON THE CROSS-SECTIONS ARE THE ELEVATIONS PRESENTED ON THE 2006 PLUS 2.16 FEET. SIMILARLY, THE GROUND SURFACE ELEVATION FOR SOIL BORINGS COMPLETED AND SURVEYED AS PART OF THE PHASE 2 AND PHASE 3 RCRA FACILITY INVESTIGATIONS HAVE BEEN ADJUSTED BY ±2.16 FEET. MONITORING WELL INFORMATION, AND 2014 AND 2015 SOIL BORINGS HAVE BEEN EVALUATED AND DEPICTED USING THE ACTUAL GROUND SURFACE ELEVATION SURVEYED IN 2015.
2. NORTHING AND EASTING GRID SHOWN ON PLAN VIEW REPRESENTS THE 2006 SURVEY.

NORTH

GRAPHIC SCALE

0 40 80 160

(IN FEET)
1 INCH = 80 FT

EXIDE VERNON RFI

EXIDE TECHNOLOGIES
VERNON, CALIFORNIA

SOIL DATA GAP WORK PLAN
PROPOSED SOIL BORINGS

ADVANCED GeoServices

Engineering for the Environment. Planning for People.™
1055 ANDREW DRIVE, SUITE A
WEST CHESTER, PENNSYLVANIA 19380
Tel: 610.840.9100 Fax: 610.840.9199 Web: www.advancedgeoservices.com

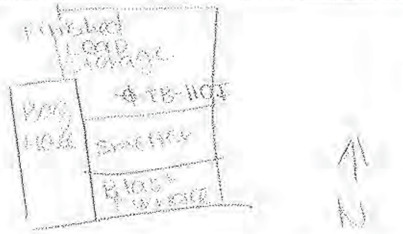
Scale	1" = 80'
Drawn By	ALC
Checked By	PGS
Project Mgr.	PGS
Originated By	ALC
Project No.	2013-3006
Drawing Date	06/09/2016
Sheet No.	2 OF
Revision Number	

FIGURE 2

F:\Projects\2013\20133006 - Exide Vernon RFI\Cad\DWGS\K_Soil_Data_Gap_work.dwg

DRAFT

Boring Location	PN: 1325.019	Client: EXIDE / BGC	Boring No. TB-110I



Boring Depth: 47.5'
Depth Ground Water Encountered: N/A
Casing Depth/Diameter: N/A

Contractor: Rice / Cascade

Drilling Method	Sampling Method	Sampling Interval
☑ Hand Auger	☐ Glass Jar	☐ 2.5 feet
☐ Hollow-Stem	☐ 2x6" Sampler	☐ 5 feet
☐ Air Rotary	☐ Split Spoon	☐ 10 feet
☐ Mud Rotary	1.5" x 18"	☐ Contin. Core
☑ Geoprobe	2" x 18"	☑ Other:
☐ Other:	3" x 12"	
	☐ Other:	
Diameter: 2"		

Location: Feed Room
Sheet 1 **of** 2

Start	Finish
Time 1015	Time 1300
Date 11-15-16	Date 11-21-16

Foreman: S. Araujo **Logged By:** E. Allen

Well Construction Summary

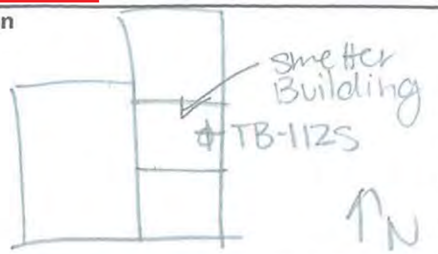
Depth (feet)	Casing	Depth (feet)	Annulus	Surface Completion:
___ to ___		___ to ___		
___ to ___		___ to ___		
___ to ___		___ to ___		

OVM (ppm)	Sample I.D.	Time	Blow Count	Casing	Annulus	Depth in Feet	USCS Designation	Color	Soil Type	Description
	HW					0				~7" of Concrete
0.00	TB-110I-1	1205				1	SM	10YR3/2 V. Dark Grayish Brown	Silty Sand	Artificial Fill. Moist, Medium dense, 80% fine to medium sand, 20% fines, trace gravel to 2", No odor, No staining
		1210				2				
0.00	TB-110I-2	1215				3				
	TB-110I-3	1217				4	SM	10YR4/2 Dark grayish Brown	Silty Sand	Native. Moist, Medium dense, 85% fine to medium sand, 15% fines, No odor, No staining
0.00	TB-110I-5	1220				5				
						6				
						7				
0.0	TB-110I-8	0710				8				
						9				
0.0	TB-110I-10					10				
						11				
						12	ML	10YR3/2 V. Dark Grayish Brown	Silt	Moist, Stiff, 80% fines, 20% fine sand, High dilatency, low plasticity, No odor, No staining
0.0	TB-110I-13	0720				13	SP			
						14				
						15	SM	10YR4/2 Brown	Poorly graded sand	Moist, Medium dense, 95% fine to medium sand, 5% fines, No odor, No staining
0.0	TB-110I-16	0725				16		10YR 4/2 Dark Grayish Brown	Silty Sand	Moist, Medium dense, 70% fine to medium sand, 30% fines, No odor, No staining
						17				
0.0	TB-110I-18	0730				18				
						19	ML			
0.8	TB-110I-20					20				V. Moist @ 18'

PN: 1325-019
Client: EXIDE / AGC
Boring No. TB-110I
Location: Vernon, CA
Sheet 2 of 2

OVM (ppm)	Sample I.D.	Time	Blow Count	Well Casing	Well Annulus	Depth in Feet	USCS Designation	Color	Soil Type	Description
						20	ML	10YR 3/2 V. Dark Grayish Brown	Silt	Moist, stiff, 60% fines, 40% fine to medium sand, trace coarse sand, High dilatency, low plasticity, No odor, No staining
0.6	2 Jars TB-110I-24 0740 DUP-1-12216		100%			21–23	CL			
						23–25		10YR 3/1 V. Dark Gray	Lean Clay	Moist, stiff, 100% fines, High plasticity, Low dilatency, No odor, No staining
0.00	3 Jars TB-110I-28 0750 MS/MSD		n/a			26–28				
						29				29-30' same as above except trace coarse sand
0.00	1 Jar TB-110I-32 0755					30	ML	10YR 3/2 V. Dark Grayish Brown	Silt	Moist, stiff, 95% fines, 5% fine sand, High dilatency, low plasticity, No odor, No staining
						32–33	CL			
0.00	1 Jar TB-110I-36 0810		100%			33–35		10YR 3/1 V. Dark Gray	Lean Clay	Moist, stiff, 100% fines, High plasticity, Low dilatency, No odor, No staining
			90%			36–37				36-37' same as above except trace gravel to 1/4"
0.00	1 Jar TB-110I-40 0830		90%			38–40				40-42.5 same as above except 90% fines, 10% fine sand
0.00	1 Jar TB-110I-44 1145		90% / 100%			41–44				
0.00	6 Jars TB-110I-46 1235		100%			45	SM	10YR 5/3 Brown	Silty Sand	Moist, Medium dense, 85% fine to medium sand, 15% fines, No odor, No staining
						46–47	SP	10YR 5/3 Brown	Poorly graded sand	Moist, Medium dense, 95% fine to medium sand, 5% fines, No odor, No staining
						47	T.D.			
						48–50				

DRAFT

Boring Location	PN: 1325.019	Client: Exide / AGC	Boring No. TB-112S
	**Drilling Method** ☐ Hand Auger ☐ Hollow-Stem ☐ Air Rotary ☐ Mud Rotary ☐ Geoprobe ☑ Other:	**Sampling Method** ☑ Glass Jar ☐ 2x6" Sampler ☐ Split Spoon 1.5" x 18" 2" x 18" 3" x 12" ☐ Other:	**Sampling Interval** ☐ 2.5 feet ☐ 5 feet ☐ 10 feet ☐ Contin. Core ☑ Other:
	Diameter: 4"		**Location** Feed Room Sheet 1 of 1 Start Time 0945 Date 11-14-16 Finish Time 0745 Date 11-28-16

Boring Depth: 20'
Depth Ground Water Encountered: N/A
Casing Depth/Diameter: N/A

Contractor: Rice / Cascade
Foreman: S. Araisa
Logged By: E. Allen

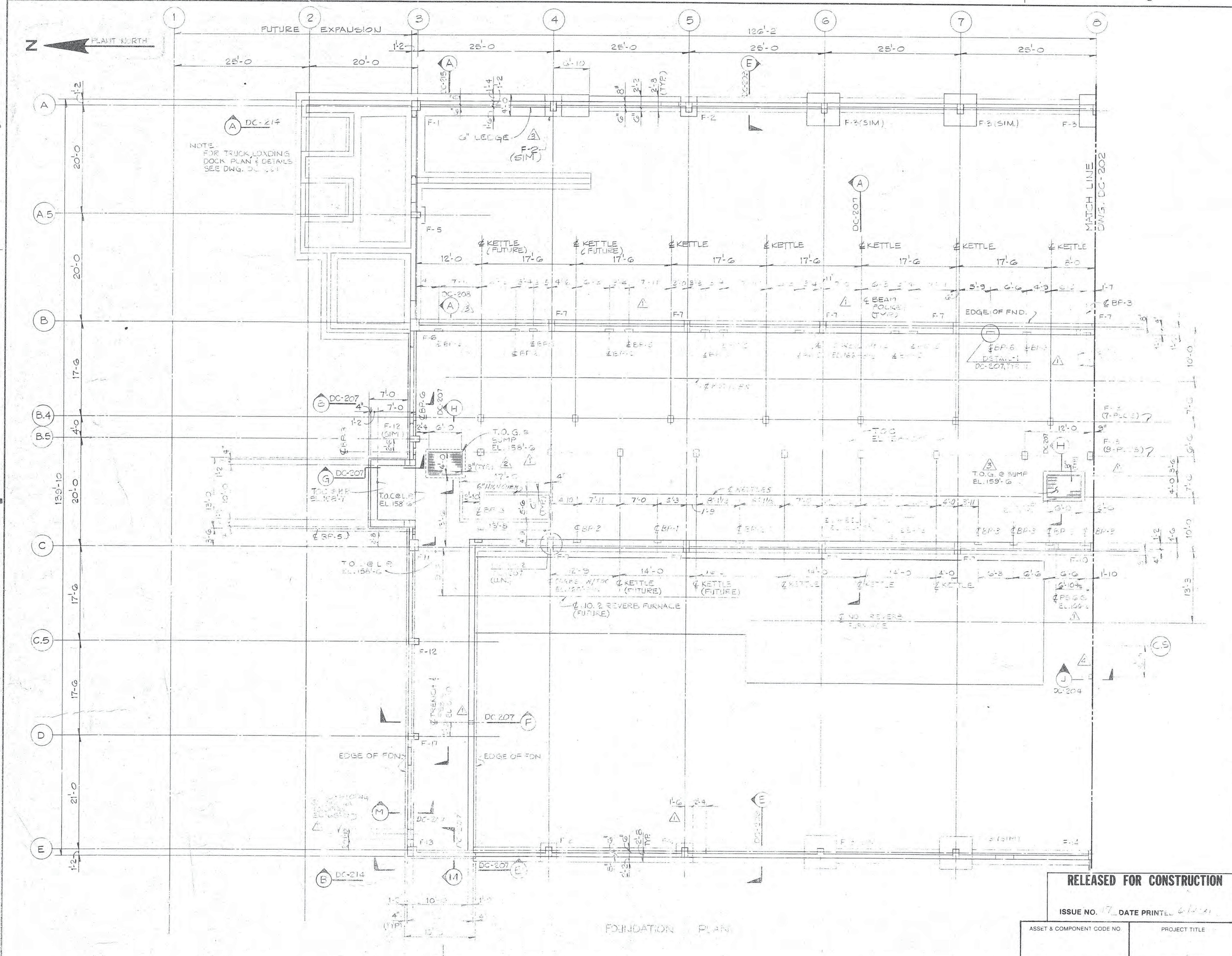
Well Construction Summary

Depth (feet)	Casing	Depth (feet)	Annulus	Surface Completion:
___ to ___		___ to ___		
___ to ___		___ to ___		
___ to ___		___ to ___		

OVM (ppm)	Sample I.D.	Time	Blow Count	Well Casing	Well Annulus	Depth in Feet	USCS Designation	Color	Soil Type	Description
0.00 2 Jars / 2 Jars / 2 Jars	TB-112S-01 / TB-112S-02 / TB-112S-03	DUP-2-111416 @ 2'	HAND AUGERED			0				~8" of Concrete
0.00 3 Jars / 2 Jars	TB-112S-04 / TB-112S-05 / TB-112S-8					1–3	SM	10YR 3/2 V. Dark grayish Brown	Silty Sand	Artificial Fill. Moist, Medium dense, 80% fine to medium sand, 20% fines, trace gravel to 1", Road base, No odor, No staining.
						4–5	SM	10YR 5/3 Brown		3-4' same as above except 70% fine to Medium sand, 30% fines
0.00 1 Jar	TB-112S-08 0725					6–8			Silty sand	Native Material. Moist, Medium dense, 85% fine to Medium sand, 15% fines, No odor, No staining
						9	ML	10YR 3/2 V. Dark Grayish Brown	Silt	Moist, soft, 60% fines, 40% fine sand, High dilatency, low plasticity, No odor, No staining
0.00 2 Jars	TB-112S-12 0730	DUP-2-112816				10	SP			
						11	SM	10YR 5/2 Grayish Brown	Poorly graded sand	Moist, Medium dense, 95% fine to medium sand, 5% fines, No odor, No staining
						12	ML			
						13–14	SP	10YR 4/2 Dark grayish Brown	Silty sand	Moist, Medium dense, 85% fine to medium sand, 15% fines, No odor, No staining
0.00 1 Jar	TB-112S-16 0735					15–16		10YR 3/2 V. Dark Grayish Brown	Silt	V. Moist, Soft, 80% fines, 20% fine sand, High dilatency, low plasticity, No odor, No staining
0.00 6 Jars	TB-112S-20 0736					17–19	SM	10YR 5/2 Grayish Brown	Poorly graded sand	Same as 9.5'-10.5'
						20	T.D.		Silty sand	Moist, Medium dense, 80% fines, 20% fine sand, No odor, No staining

Trace coarse sand from 19'-20'

T.D. @ 20'



BEAM POCKET SCHEDULE	
BEAM POCKET - BP ELEVATIONS	
BP Nº	EL. T.O.C.
1	165'-8½
2	166'-2½
3	166'-3
4	166'-6
5	166'-8¾
6	167'-2½

NOTES:

1. FOR GENERAL CONCRETE NOTES SEE DWG. DC-021.
2. WORK THIS DRAWING WITH DWG. DC-202.
3. ... TO BE SIMILAR TO THOSE SHOWN ON DRAWING DC-151

REFERENCE

GENERAL ARRANGEMENT - SMELTER	DM-100 &
AREA - PLAN @ EL. 156'-6 T.O.C.	DM-101
GENERAL ARRANGEMENT - BAGHOUSE &	DC-115 &
SCRUBBER AREA - PLAN @ GRADE EL. 168'-0 (NOM.)	DC-116
SMELTER AND REFINING BLDG. PIPING PLAN - COLS. 2-4 & C-D	DP-206
SMELTER AND REFINING BLDG. PIPING PLAN - COLS. 7-10 & D-E	DP-211
SMELTER AREA - CONCRETE - PIER DETAILS	DC-204 THRU DC-206
SMELTER AREA - CONCRETE - CAISSON LOCATION PLAN AND DETAILS.	DC-203

NO	BY	DESCRIPTION	J.E.	S.E.
5		ADDED NOTE NO. 3		
4	LP	ADDED SECTION J		
3	TAF 10-6-80	ADDED SECT. DU-A, 6" LEDGE TO WALL BTWN. COL. LINE 3-4 & 4-A, ...		
2	EMC	REVISED STAIR ENCLOSURE CURB		

REVISIONS

GOULD INC., METALS DIV.
ST. PAUL, MINNESOTA
WEST COAST SMELTER

SMELTER AREA
CONCRETE
FOUNDATION PLAN SHEET 1 OF 2

RELEASED FOR CONSTRUCTION

ISSUE NO. 17 DATE PRINTED 6-12-81

Dravo Engineers and Constructors

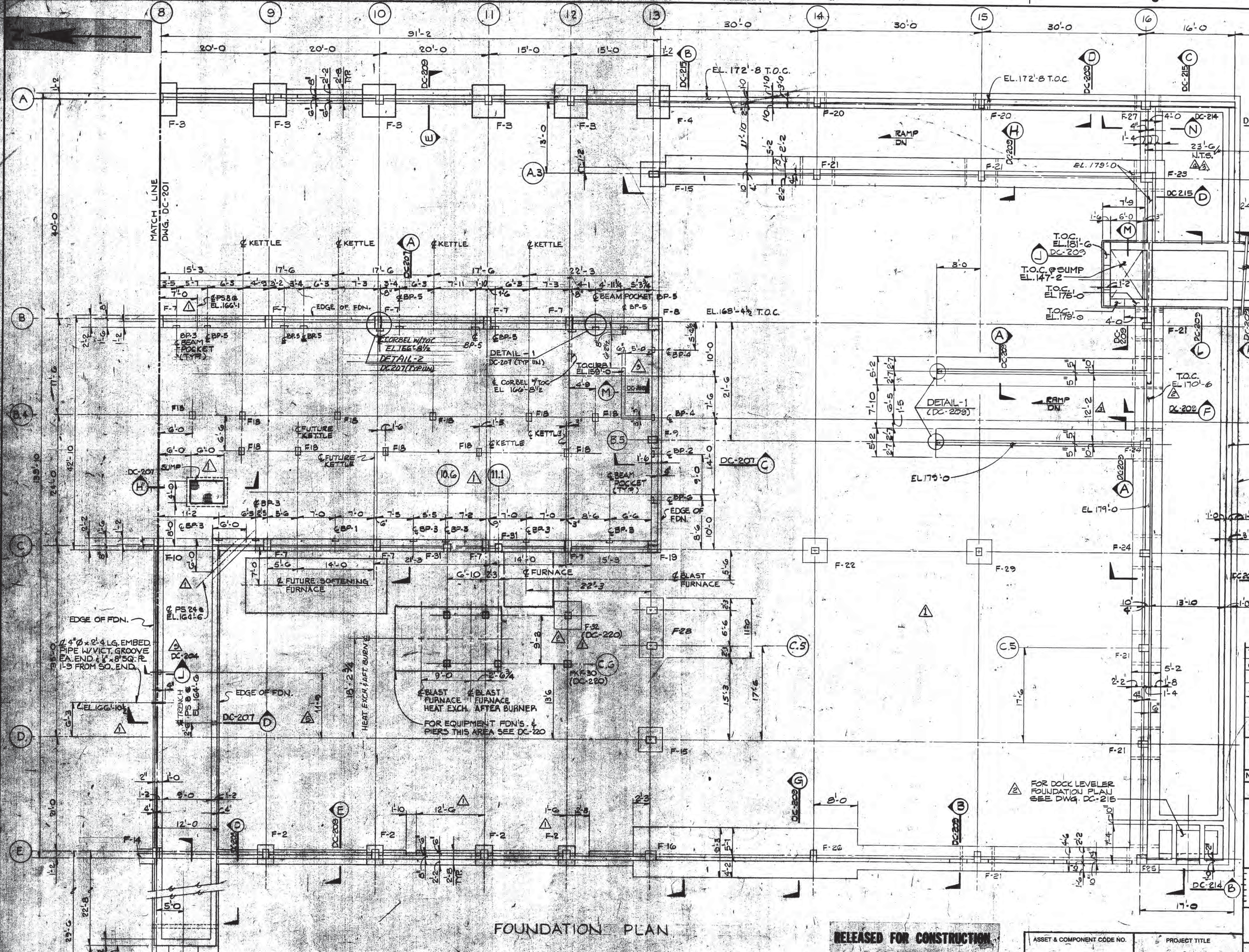
Denver Division

ASSET & COMPONENT CODE NO. | PROJECT TITLE

DR TAF | SCALE | CHF. S.E.
CH | SECT | APP'D
J.E. | AREA | APP'D

Contract M-7569
Drawing Number DC-201
Rev

GNBVM 000119



NOTES

1. FOR NOTES & REFERENCE DRAWINGS SEE DWG. DC-201
2. SUMP PUMP SUPPORTS TO BE SIMILAR TO THOSE SHOWN ON DRAWING DC-251.

RECEIVED APR 24 1981 DRAVO

NO	BY	DESCRIPTION	J.E.	S.E.
7	4-15-81	ADDED NOTE NO. 2	4/15/81	4/15/81
6	CLP	REMOVED HOLD 4	1/19/81	1/19/81
5	CLP 1/7/81	ADDED SECTION-J	1/7/80	1/7/81
4	EMC 10-16-80	REV. DIM TO R.R. & REV. FOOTING @ WALL REMOVED HOLD #5	WG 10/16/80	WG 10/16/80
3	BW 10-6-80	MOVED EAST RAMP WALL @ STOR. AREA ADDED CURB @ GALLERY, BP-4, MOVED R.R. SPUR	WG 10/2/80	10/6/80
2	BW 9/25/80	ADDED: DETAIL-1, F-32, DOCK LEVELER, SECT-N & REVISED WALL @ COL LINE-16	WG 9/25/80	9/25/80
1	EMC 9/4/80	REMOVED HOLDS 1, 2, & 3. ADDED PIPE SLEEVES AND ELECT. OPNGS, ADDED PIERS F-30 & F-31, RELEASED FOR CONSTRUCTION.	WTG 9/3/80	9/3/80

REVISIONS

GOULD INC., METALS DIV.
ST. PAUL, MINNESOTA
WEST COAST SMELTER

SMELTER AREA
CONCRETE
FOUNDATION PLAN - SHEET 2 OF 2

Dravo Engineers and Constructors

Denver Division

Dravo

RELEASED FOR CONSTRUCTION

ISSUE NO. 17 DATE PRINTED 4-15-81

ASSET & COMPONENT CODE NO.

PROJECT TITLE

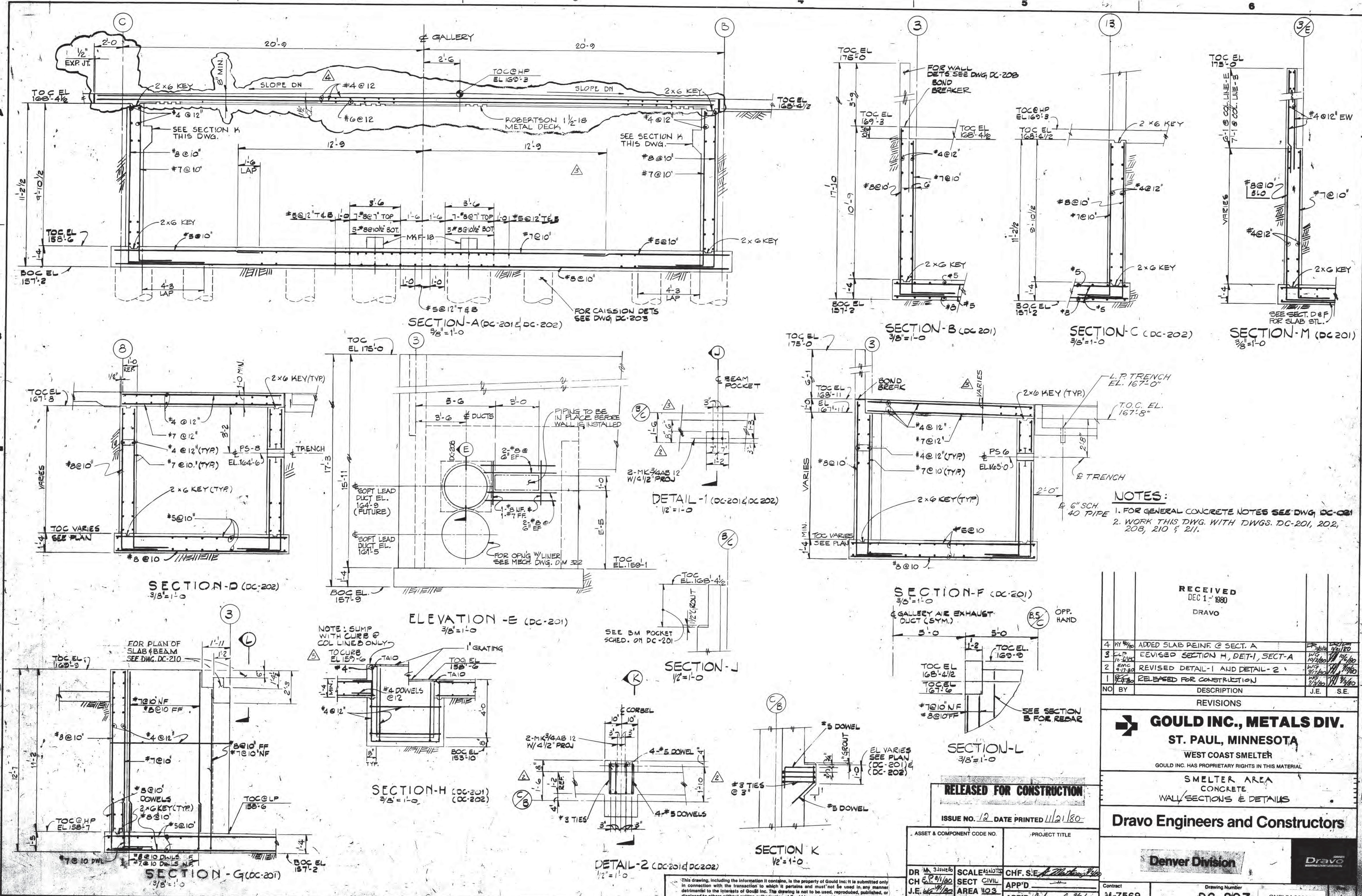
DR TAF 9/2/80 | SCALE 1/8"=1'-0 | CHF. S.E.
CH E.P. 9/1/80 | SECT CIVIL | APP'D
J.E. WG 9/1/80 | AREA 103 | APP'D

Contract M-7569

Drawing Number DC-202

GNBVM 002579

Rev. 7


SECTION-A (DC-201 & DC-202)
3/8"=1'-0
SECTION-B (DC 201)
3/8"=1'-0
SECTION-C (DC-202)
3/8"=1'-0
SECTION-M (DC 201)
3/8"=1'-0
SECTION-D (DC-202)
3/8"=1'-0
ELEVATION-E (DC-201)
3/8"=1'-0
DETAIL-1 (DC-201 & DC 202)
1/2"=1'-0
SECTION-F (DC-201)
3/8"=1'-0
SECTION-J
1/2"=1'-0
SECTION-L
3/8"=1'-0
SECTION-G (DC-201)
3/8"=1'-0
SECTION-H (DC-201) (DC-202)
3/8"=1'-0
DETAIL-2 (DC-201 & DC202)
1/2"=1'-0
SECTION K
1/2"=1'-0
FOR CAISSION DETS SEE DWG DC-203
ROBERTSON 1 1/2-18 METAL DECK
NOTES:
1. FOR GENERAL CONCRETE NOTES SEE DWG DC-001
2. WORK THIS DWG. WITH DWGS. DC-201, 202, 208, 210 & 211.
RECEIVED DEC 1 1980 DRAVO
4 ADDED SLAB REINF. @ SECT. A
3 REVISED SECTION H, DET-1, SECT-A
2 REVISED DETAIL-1 AND DETAIL-2
1 RELEASED FOR CONSTRUCTION
NO BY DESCRIPTION J.E. S.E.
REVISIONS
GOULD INC., METALS DIV.
ST. PAUL, MINNESOTA
WEST COAST SMELTER
GOULD INC. HAS PROPRIETARY RIGHTS IN THIS MATERIAL
SMELTER AREA
CONCRETE
WALL SECTIONS & DETAILS
Dravo Engineers and Constructors
Denver Division
RELEASED FOR CONSTRUCTION
ISSUE NO. 12 DATE PRINTED 11/21/80
ASSET & COMPONENT CODE NO.
PROJECT TITLE
SCALE AS NOTED
SECT CIVIL
AREA 103
CHF. S.E.
APP'D
Contract M-7569
Drawing Number DC-207
GNBVM 000099
4
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Attachment D

JHA/JSA Examples

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Job Hazards Analysis

Project Name: **PG&E Rotor Handling**	Job No: **10-04-028136**	Date:	Scheduled:
Location: **Belden CA.**	Customer: **PG&E**		Revised:
Required Personal Protective Equipment: **Fall protection, Hard Hats, Safety Glasses, Vest, Gloves**		Analysis by: **JW Howard**	Date:
Description **Specialized Rigging**	A/D Director: Controlling Entity: Site Supervisor: Lift Director: **JW Howard** Crane User:	Reviewed by: **Harry A Wagner**	Date:
Work Operation: **Gantry setup and Lifting of equipment**		Approved by:	Date:

Date	Execution Process	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
	1. Offloading trucks, and Layout	Clear path of Travel Storage of Equipment Ground and site conditions Overhead loads	Watch trucks and equipment to offload trucks, make eye contact with operators and have spotters. Pinch points with crib and eye contact with operator Insure all personnel is wearing correct PPE and make note of ground conditions, watching footing, etc. Tag lines on loads and spotters, stay clear	Keep equipment clean and free of slip/trip hazards. Use equipment to move materials in lieu of manual handling. All personnel stay away from pinch points, rigging integrity, and suspended loads. Monitor wind and weather restrictions Site supervision shall ensure; Access roads for loads are appropriately compacted and have adequate space to move equipment. Ground conditions for Gantry to mobilize and setup as well as build out for gantry attachments when necessary. Monitor wind and weather restrictions. Coordinate co-occupation work tasks to ensure other crafts are not in harms way or create hazardous conditions for the tower erection.

	2.Gantry Set up	Check rigging Follow engineered plans Falling Objects Caught between/Crushing Pinch points Slips Trips and Falls Overhead loads	Watch trucks and equipment to offload trucks, make eye contact with operators and have spotters. Pinch points with crib and eye contact with operator Insure all personnel is wearing correct PPE and make note of ground conditions, watching footing, etc. Follow procedure and drawings from engineer to insure proper set up. Watch hand location when setting up equipment, maintain good communication with operators. Tag lines, spotters	Gantry erection supervisor shall ensure; Rigging inspection and practices/ Fall protection is inspected and used during all fall potentials 6' and higher/ Erection plan is exactly followed and when deviations are required then job shall stop and new requirements effectively communicated with all personnel. Ensure working surfaces are kept free of slippery conditions Site supervision shall ensure; Access roads for loads are appropriately compacted and have adequate space to move equipment. Ground conditions for gantry crane to mobilize and setup as well as build out for attachments when necessary. Coordinate co-occupation work tasks to ensure other crafts are not in harms way or create hazardous conditions for the tower erection.
	3. Rigging up the piece to be lifted	Check rigging Falling from heights Follow engineered plans Falling Objects Caught between/Crushing Pinch points Slips Trips and Falls Overhead loads	Same as previously mentioned in addition to the following; Ground work will require the use of ladders for elevated work position and tie-off when working higher then 6', careful consideration shall be given to tie off points that do not exceed rip and elongation distance requirements of 11.5 feet with personal fall protection. Be careful when placing slings over trunnions and make sure riggers are in contact with operator of pumps before snugging up. Remove, mud and grease/Hydraulic fluid from working surfaces.	Gantry erection supervisor shall ensure; Rigging inspection and practices/ Fall protection is inspected and used during all fall potentials 6' and higher/ Erection plan is exactly followed and when deviations are required then job shall stop and new requirements effectively communicated with all personnel. Ensure working surfaces are kept free of slippery conditions Site supervision shall ensure; Access roads for loads are appropriately compacted and have adequate space to move equipment. Coordinate co-occupation work tasks to ensure other crafts are not in harms way or create hazardous conditions for the tower erection.

	4. Lifting the Piece	Binding point Plumbness of gantries Speed and operation Path is clear of obstructions and material Pinch points Slips Trips and Falls Overhead loads	Same as previously mentioned in addition to the following; Operator of jacks pay attention to the load cell. Check all gantry legs that they are still plumb. Low speed will be used at all times when lifting with load, spotters will notify operator of progress Headers are level	Gantry erection supervisor shall ensure; Rigging inspection and practices/ Fall protection is inspected and used during all fall potentials 6' and higher/ Erection plan is exactly followed and when deviations are required then job shall stop and new requirements effectively communicated with all personnel. Ensure working surfaces are kept free of slippery conditions and mud, grease/Hydraulic fluid is removed. Site supervision shall ensure; Access roads for loads are appropriately compacted and have adequate space to move equipment. Coordinate co-occupation work tasks to ensure other crafts are not in harm's way or create hazardous conditions
	5. Lowering of load	Rigging failures, Suspended loads, fall exposures when setting piece, pinch points, manual manipulation of piece to fit adjustment, wind/weather restrictions, Work from ladders Other hazards are common to same hazards previously mentioned, slip and trip hazard due to grease.	Same as previously mentioned in addition to the following. Rigging should be visually inspected prior to each lift, personnel shall be warned to evacuate area under suspended load, wind and weather shall be monitored and work stopped when adverse conditions exist. Insure all personnel is aware of surroundings and no one is under load when lowering is taking place. Make sure operator and spotter are in communication when rigging is cut loose to insure proper control of gantry and headers.	Gantry erection supervisor shall ensure; Rigging inspection and practices/ Fall protection is inspected and used during all fall potentials 6' and higher/ Erection plan is exactly followed and when deviations are required then job shall stop and new requirements effectively communicated with all personnel. Ensure working surfaces are kept free of slippery conditions and mud, grease/Hydraulic fluid is removed. Site supervision shall ensure; Access roads for loads are appropriately compacted and have adequate space to move equipment. Coordinate co-occupation work tasks to ensure other crafts are not in harm's way or create hazardous conditions

Additional Comments (include any additional observations or comments on this job task below)

All personnel shall review the job safety analysis prior to work activity and sign below. Perimeter of work area shall have yellow caution or red warning tape installed to prevent any unnecessary jobsite personnel being exposed to these hazards.

PRINT	SIGNATURE

Assembly/Disassembly Director:

Date:

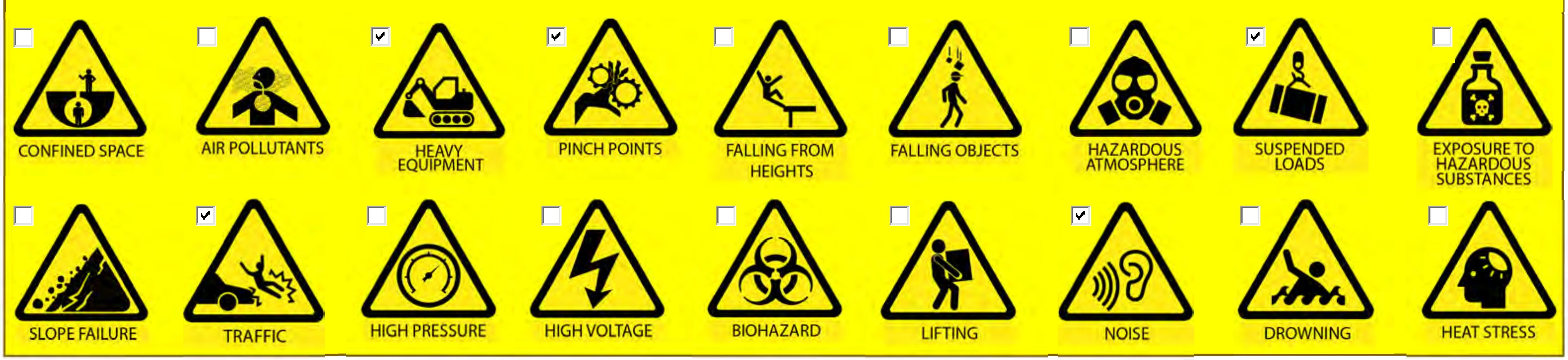
AIS-16/JSA

American Integrated Services, Inc.

JOB TASK:	DATE:	21JUL2016	PREPARED BY:	Dan Wallace
Decontamination	LOCATION:	Exide, Vernon	REVIEWED BY:	

PERSONAL PROTECTIVE EQUIPMENT REQUIRED:	TRAINING REQUIRED:	PERMITS NEEDED:
Hard Hat, Safety Glasses, Steel Toe Boots, Gloves, Traffic Vest	40 hr. Hazwoper	

SITE SPECIFIC HAZARD IDENTIFICATION



Critical Job Steps	Potential Risk	Critical Actions
Mobilizing/Demobilizing Equipment	Exposure to dust	Steel-toed, steel-shank boots. Hard hat. Safety glasses with side shields. Brightly colored safety vest if working near vehicular traffic. Gloves outer, PVC. Gloves inner, nitrile. Long pants and long sleeve shirts, Tyvek®/coveralls.

		Face shield (decontamination task with steam/pressure washers). Hearing protection (as necessary).
Decon equipment with pressurized water	Slips, trips and falls	Visually inspect equipment, make sure it is in good working condition. Survey the job site to locate the area where the equipment will be located. Area should be free of tools and debris. Limit wand and hose exposure by parking equipment near the area to be cleaned. Wear appropriate gloves, safety glasses, and steel toed boots when handling equipment. Make sure work area is void of tripping hazard. Survey the area and material you will be cleaning. Place traffic cones behind equipment as needed to alert vehicular traffic.
Setting up decontamination area	Slips, trips and falls	Work area shall be visually inspected, and slip, trip, and fall hazards shall be marked, barricaded, or eliminated, if feasible. Use care in work area; look for depressions and obstructions.
Decon Personnel Station 1	Exposure to hazardous substances Slips, trips and falls Contamination of soil	Work area shall be visually inspected, and slip, trip, and fall hazards shall be marked, barricaded, or eliminated, if feasible. Use care in work area; look for depressions and obstructions. Deposit contaminated tools in a contained area While worker stand in a shallow plastic tub, remove tape, if worn, from gloves and boots. Scrub boots with scrubbing brush
Decon Personnel Station 2	Slips, trips and falls	Work area shall be visually inspected, and slip, trip, and fall hazards shall be marked, barricaded, or eliminated, if feasible. Use care in work area; look for depressions and obstructions.

		Remove boots if needed and outer gloves. Deposit in designated containers. Remove protective clothing if applicable and deposit in designated containers.
Decon Personnel Station 3	Slips, trips and falls	Work area shall be visually inspected, and slip, trip, and fall hazards shall be marked, barricaded, or eliminated, if feasible. Use care in work area; look for depressions and obstructions. Wash hands and face with mild soap at the hand wash station.

I understand and agree to the conditions of this JSA					
Print name	Signature	Date	Print name	Signature	Date

AIS-16/JSA

American Integrated Services, Inc.

JOB TASK:		DATE: 21JUL2016	PREPARED BY: Dan Wallace
Deconstruction		LOCATION: Exide, Vernon	REVIEWED BY:

PERSONAL PROTECTIVE EQUIPMENT REQUIRED:

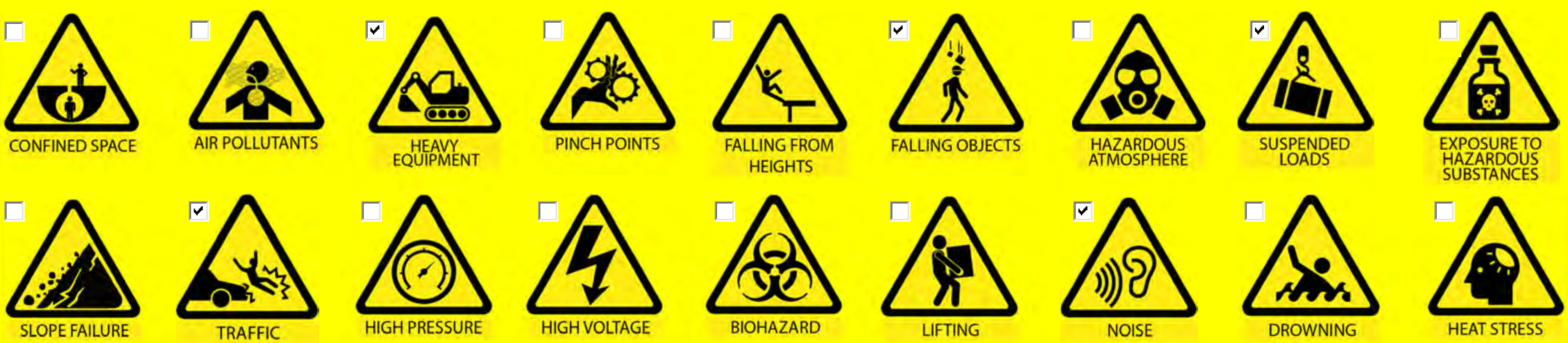
Hard Hat
Safety Glasses
Steel Toe Boots
Gloves

TRAINING REQUIRED:

40 Hr. Hazwoper

PERMITS NEEDED:

SITE SPECIFIC HAZARD IDENTIFICATION



Critical Job Steps	Potential Risk	Critical Actions
Demolition	Struck by/ crushing hazards	Good communication and eye contact between the spotter and the operator. Stay out of the swing radius of the equipment. Stand clear of the structure being demo'd.
	Demolition debris falling onto the equipment	Trained operator knowing the proper sequence of demoing the structure. Keep equipment as far away from structure as possible.

	Structure not collapsing after removing portions of the structural supports	Remove key structural points individually and wait temporarily to see how structure falls before removing more. Review as built drawing for structural support.
	Excessive dust	Water as needed for dust suppression. Use an N-95 dust mask or respirator with the proper cartridges.
	Debris blowing off site or being drug around the site	Compact trash pile regularly to prevent material from moving around/ blowing off-site. Moisten stockpile. Cover stockpile with visqueen (If necessary)
	Injury from the structure collapsing on others	U Keep all unnecessary workers out of the work zone. Spotter and operator watching for unauthorized people entering the exclusion zone. Assure structure has no occupants before work begins.
	Damage to adjoining structures or adjoining properties	Watch hand/ body placement and use of barriers/ heat shields between hot working surfaces and skin.
	Fire.	Use spotters to watch property lines and communicate with the lead operator as to how the structure is falling.
	Overturning the machine during demolition work	• Trained operator. • Read the operators manual for the machine. • Know the working limits of the equipment. • Operate on level surfaces if possible. • Move the equipment slowly over rough terrain/ uneven surfaces.

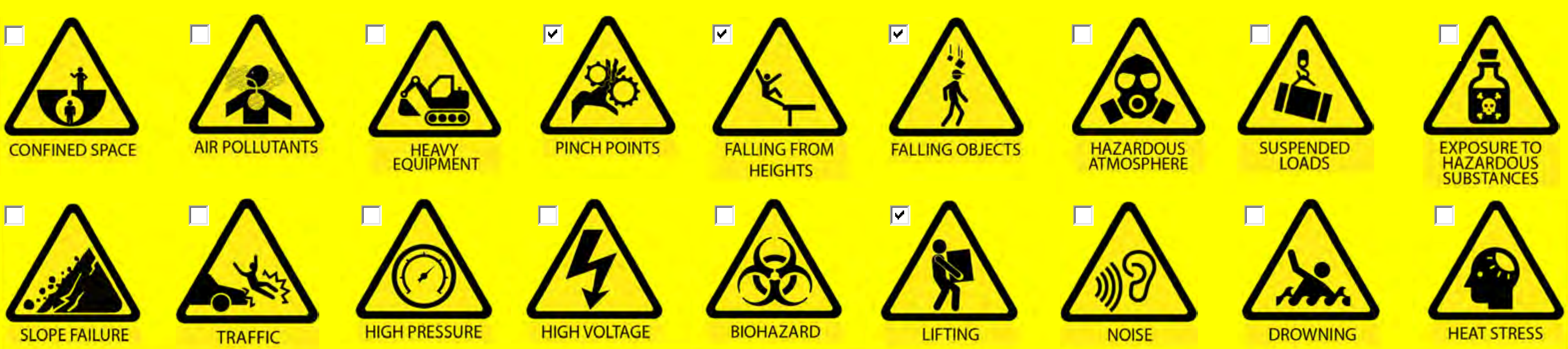
I understand and agree to the conditions of this JSA					
Print name	Signature	Date	Print name	Signature	Date

AIS-16/JSA

American Integrated Services, Inc.

JOB TASK:		DATE:	21JUL2016	PREPARED BY:	Dan Wallace
Scaffold Installation		LOCATION:	Exide, Vernon	REVIEWED BY:	
PERSONAL PROTECTIVE EQUIPMENT REQUIRED:		TRAINING REQUIRED:		PERMITS NEEDED:	
Hard Hat, Safety Glasses, Steel Toe Boots, Gloves, Traffic Vest		40 hr. Hazwoper			

SITE SPECIFIC HAZARD IDENTIFICATION



Critical Job Steps	Potential Risk	Critical Actions
Scaffold set up and erection.	Falls from window openings or through floor openings. Falling from elevation. Falling from ladders. Tools, materials falling from workers overhead. Trips, slips and falls on piles of scrap or building material, holes in the ground, and or debris. Scaffold collapses	Review site work plan with all employees before set-up to ensure no hazards created for crew and everyone understands work plan. Discuss hazards and AHA. Remain within the guardrails at all times. Set up safe work zone with delineators, caution tape and signs. A crew chief trained and evaluated in scaffold set-up, will direct set-up.

	Scaffold falls or overturns on employees or employees fall from scaffold.	Scaffold will be set up per manufacturer directions. Set up crew will have body harness and lanyard and be tied off when working above 6 feet unless using a lanyard and body harness causes the installer to be at a greater risk. Scaffolding must be assembled, inspected daily, and dismantled by a competent person. Scaffold must be tagged near the access by the competent person showing when it is being assembled and when it is ready for use. All scaffold, including must have guardrails when the standing platform is at or greater than 6‘. Hard hats will be required at all work site locations. Any building access over 18‖ step-up presents a tripping/falling hazard. Review building access with general contractor to ensure safe stair or ramp access provided prior to crew arrival. Review site with general contractor; ensure all openings have been guarded All planks will be inspected prior to use. Crews will ensure wheel locks are set & working properly each time the scaffold is moved. Only Type 1A step ladders will be used. All workers will be trained on safe ladder use. Ladder use will be addressed in the initial crew safety meeting
Walking by or under scaffold.	Tools, materials falling from workers overhead. Scaffold collapses Scaffold falls or overturns on employees or employees fall from scaffold.	Review site with general contractor before set-up to ensure no hazards created for people entering and exiting building. Provide awning at entrance and exits if scaffolding will be over entryway. Set up work area using delineators and caution tape. Do not allow people to enter work zone. Hoist tools/materials via bucket
Dismantling scaffold.	Falls from window openings or through floor openings. Falling from elevation.	A crew chief, trained and evaluated in scaffold dismantling, will direct set-up.

	Falling from ladders. Tools, materials falling from workers overhead. Trips, slips and falls on piles of scrap or building material, holes in the ground, and or debris.	Scaffold will be dismantled per manufacturer directions. Dismantling crew will have body harness and lanyard and be tied off when working above 6 feet unless using a lanyard and body harness causes the dismantler to be at a greater risk. Hard hats will be required at all work site locations. Review site with general contractor; ensure all openings and windows have been guarded.

I understand and agree to the conditions of this JSA

Print name	Signature	Date	Print name	Signature	Date

AIS-16/JSA

American Integrated Services, Inc.

JOB TASK:		DATE:	21JUL2016	PREPARED BY:	Dan Wallace
Saw Cutting - Concrete, Asphalt, Steel		LOCATION:	Exide, Vernon	REVIEWED BY:	

PERSONAL PROTECTIVE EQUIPMENT REQUIRED:
Hard Hat, Safety Glasses, Steel Toe Boots, Gloves, Traffic Vest

TRAINING REQUIRED:
40 hr. Hazwoper

PERMITS NEEDED:

SITE SPECIFIC HAZARD IDENTIFICATION

- [ ] CONFINED SPACE
- [x] AIR POLLUTANTS
- [ ] HEAVY EQUIPMENT
- [x] PINCH POINTS
- [ ] FALLING FROM HEIGHTS
- [ ] FALLING OBJECTS
- [ ] HAZARDOUS ATMOSPHERE
- [ ] SUSPENDED LOADS
- [x] EXPOSURE TO HAZARDOUS SUBSTANCES
- [ ] SLOPE FAILURE
- [ ] TRAFFIC
- [ ] HIGH PRESSURE
- [x] HIGH VOLTAGE
- [ ] BIOHAZARD
- [ ] LIFTING
- [x] NOISE
- [ ] DROWNING
- [ ] HEAT STRESS

Critical Job Steps	Potential Risk	Critical Actions
Equipment fueling and inspection	Pinch points/ cuts/ abrasions Fuel contact with skin/eyes Fire	Proper PPE including gloves Watch hand placement. Assure compartment doors are locked in the open position during inspection. Use of Nitrile or rubber gloves. Wear safety glasses. Use of a face shield while fueling (As needed).

		Fire extinguisher with current inspection tag in the fueling area. Do not fuel equipment if fueling is exposed to a hot engine. Assure ignition is turned off (If so equipped).
Connection of a Water Hose	Slip trips falls. Pinch Points	Plan the travel route for the hose avoiding trip/ fall hazards. Move obstructions that are in your walking path. Watch your footing on wet surfaces Proper PPE including gloves. Watch hand placement.
Blade Installation	Installing the wrong saw blade causing the blade to break apart Hand injuries during blade installation Back strain installing the blade	Assure saw blade is correct for the task. Asphalt cutting blades cannot cut concrete causing blade failure or breaking into pieces. Wear leather or level II cut resistant gloves. Use caution while handling the blade. Use the correct tool to tighten the blade onto the machine. Bend at the knees while installing and tightening the blade to the machine. Firm grip in the wrench while tightening the blade to the machine. Use your arm strength, not your back to tighten.
Site Prep to Cut	Cutting unknown buried obstructions below the concrete/ asphalt Cutting in the wrong location	Reference as built drawings for buried obstructions. If a plant manager is available, consult with him for unknown obstructions. If applicable, call Dig Alert to mark utilities. Perform a sub-surface survey. Mark location of saw cutting. Confirm layout with others before beginning.
Cutting	Dust/ odor control. Excessive noise	Get help to wet the cutting area as needed for dust suppression or hook water to machine for automatic water feeding.

	Back strain while maneuvering the machine. Eye injuries Slips trips falls Skin contact with the slurry residue Machine kickback causing bodily injury	Use an N-95 dust mask or respirator with the proper cartridges. Wear hearing protection including ear plugs or ear muffs. Get help from others (if needed) to move or turn the machine. Proper PPE including safety glasses. All who are working immediately around the saw must wear a face shield while saw cutting. Plan your route before cutting. Remove tripping hazards before cutting. Watch your footing on wet surfaces. Avoid walking on the slurry residue. Watch your footing around the water hose. Wear proper PPE including safety glasses, face shield, rubber gloves & boots, long sleeve shirt and an apron Be patient and don't feed the machine faster than it can safely cut.
Clean Up	Electrocution during vacuuming Excessive noise while vacuuming Back strain while maneuvering or emptying the vacuum. Slips trips falls Skin contact with the slurry	Inspect vacuum and cord before use for signs of wear or damage. Remove cords from service if there are cuts in the outer jacket exposing the wire or if the ground prong was removed. Keep cords out of water. Plug into a GFCI protected circuit. Equipment and cords can only be repaired by the original manufacturer. Wear hearing protection including ear plugs or ear muffs. Get help with awkward or heavy loads.

		If no help is available, empty/ drain or the vacuum often before it becomes too heavy. Use a small bucket to empty the contents out of the vacuum. Watch your footing on wet surfaces while vacuuming the slurry. Avoid stepping in the slurry residue. Clear the work area of obstructions in the walking path. Wear proper PPE including rubber gloves, face shield, apron and rubber boots (as necessary).

I understand and agree to the conditions of this JSA					
Print name	Signature	Date	Print name	Signature	Date

Attachment E

Preliminary Cribbing Sketch

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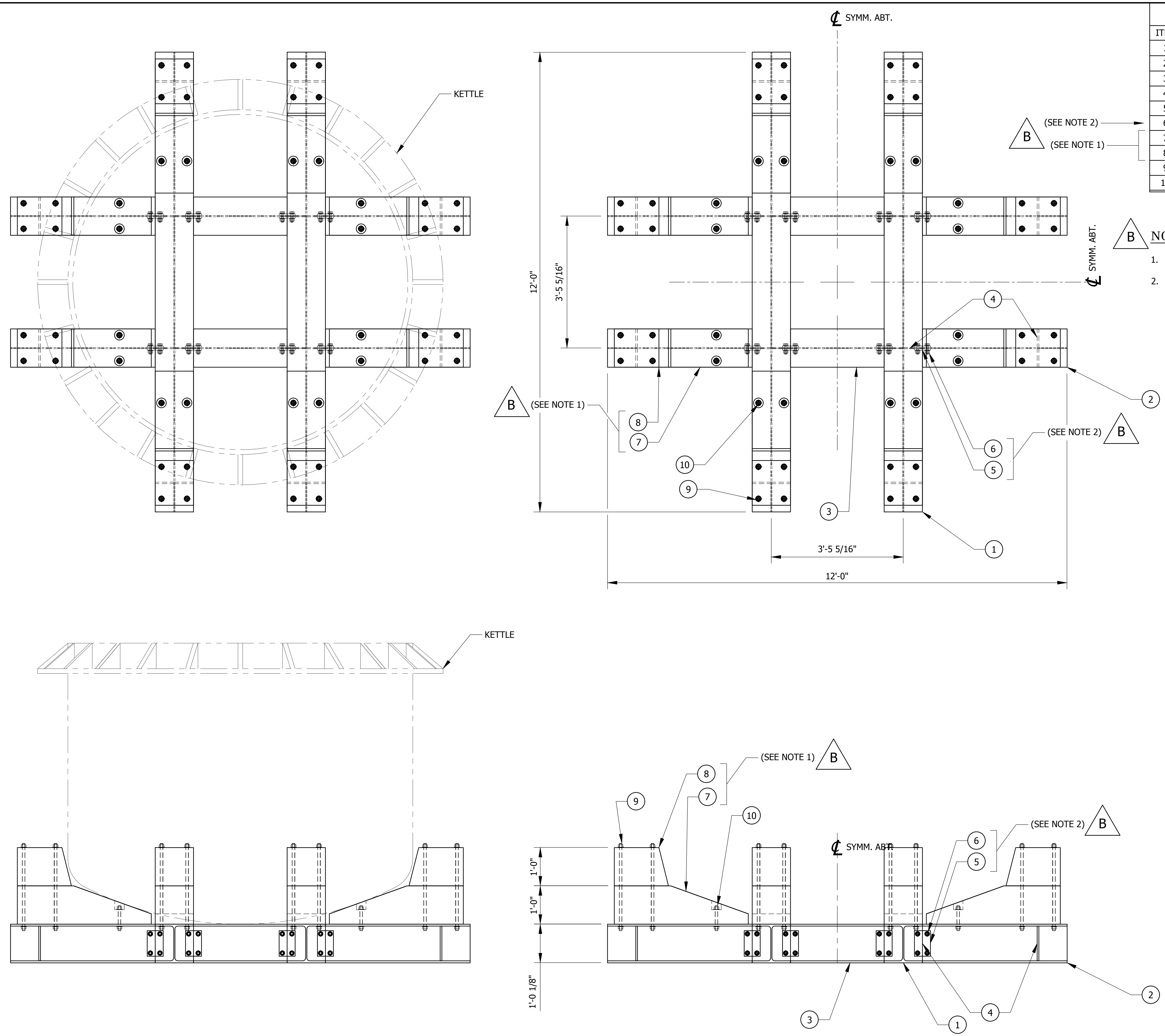

PARTS LIST			
ITEM	QTY	DESCRIPTION	WEIGHT EA. (LBS)
1	2	W12x65 x 12'-0"	780
2	4	W12x65 x 3'-9 5/16"	245
3	2	W12x65 x 2'-5 5/16"	159
4	24	PL 3/8 x 5 1/2 x 10 3/4	6
5	16	PL 3/8 x 5 x 8	4
6	32	BOLT Ø3/4 x 2 3/4, W/N&W	1
7	8	TIMBER 12 x 12 x 3'-6"	140
8	8	TIMBER 12 x 12 x 1'-6"	60
9	32	THREADED ROD Ø7/8 x 2'-4", W/(2)N & (2)W	5
10	16	THREADED ROD Ø7/8 x 8, W/(2)N & (2)W	1

TOTAL EST. WT. = 4887 LBS

B NOTES:

1. FUNCTIONALLY SIMILAR STEEL SUBASSEMBLIES MAY BE SUBSTITUTED FOR ALL TIMBER ITEMS, AS REQUIRED.
2. WELDED JOINTS MAY BE SUBSTITUTED FOR ALL STEEL-TO-STEEL BOLTED CONNECTIONS, AS REQUIRED.

PRELIMINARY

NOT FOR CONSTRUCTION

NO.	REVISIONS	DATE	BY	DATE	BY	DATE	BY
B	ADD NOTES	12/02/16	DCG	---	---	---	---
A	PRELIMINARY ISSUE	12/03/16	DCG	---	---	---	---
		DRAWN		CHECKED		APPROVED	

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KETTLE TEMPORARY SUPPORT (CONCEPTUAL)
PLAN & ELEVATION VIEWS
EXIDE KETTLE REMOVAL
AMERICAN INTEGRATED SERVICES

SCALE: (U.N.O)	SIZE	PROJECT No.	DWG. No.	SHEET	REV.
3/8" = 1'-0"	B	10-04-032165	SK-20161202-1	1 of 1	B

Attachment F

Typical Cutting Saw

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HILTI

DSH 700
DSH 700-X
DSH 900
DSH 900-X

English en
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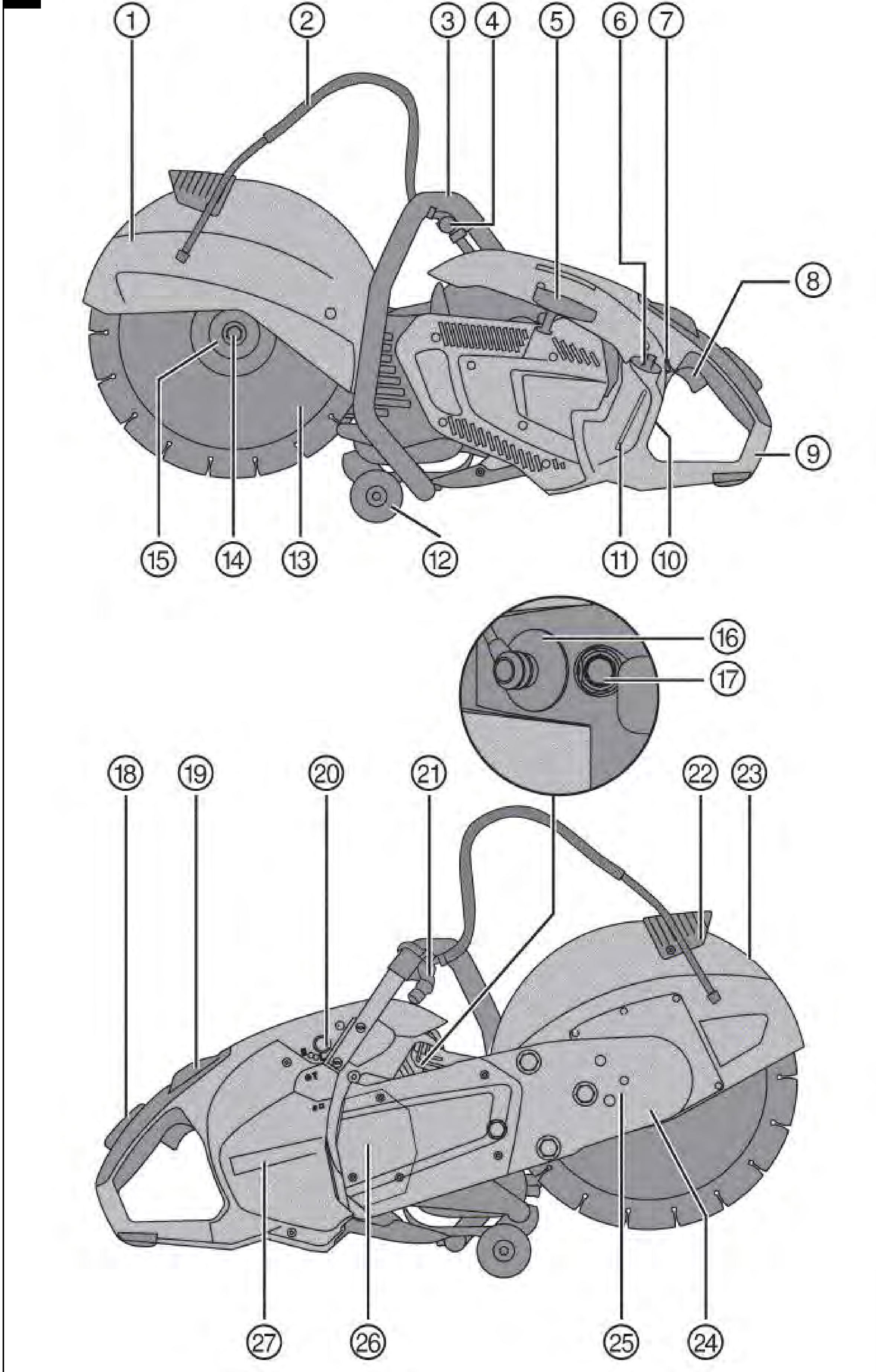

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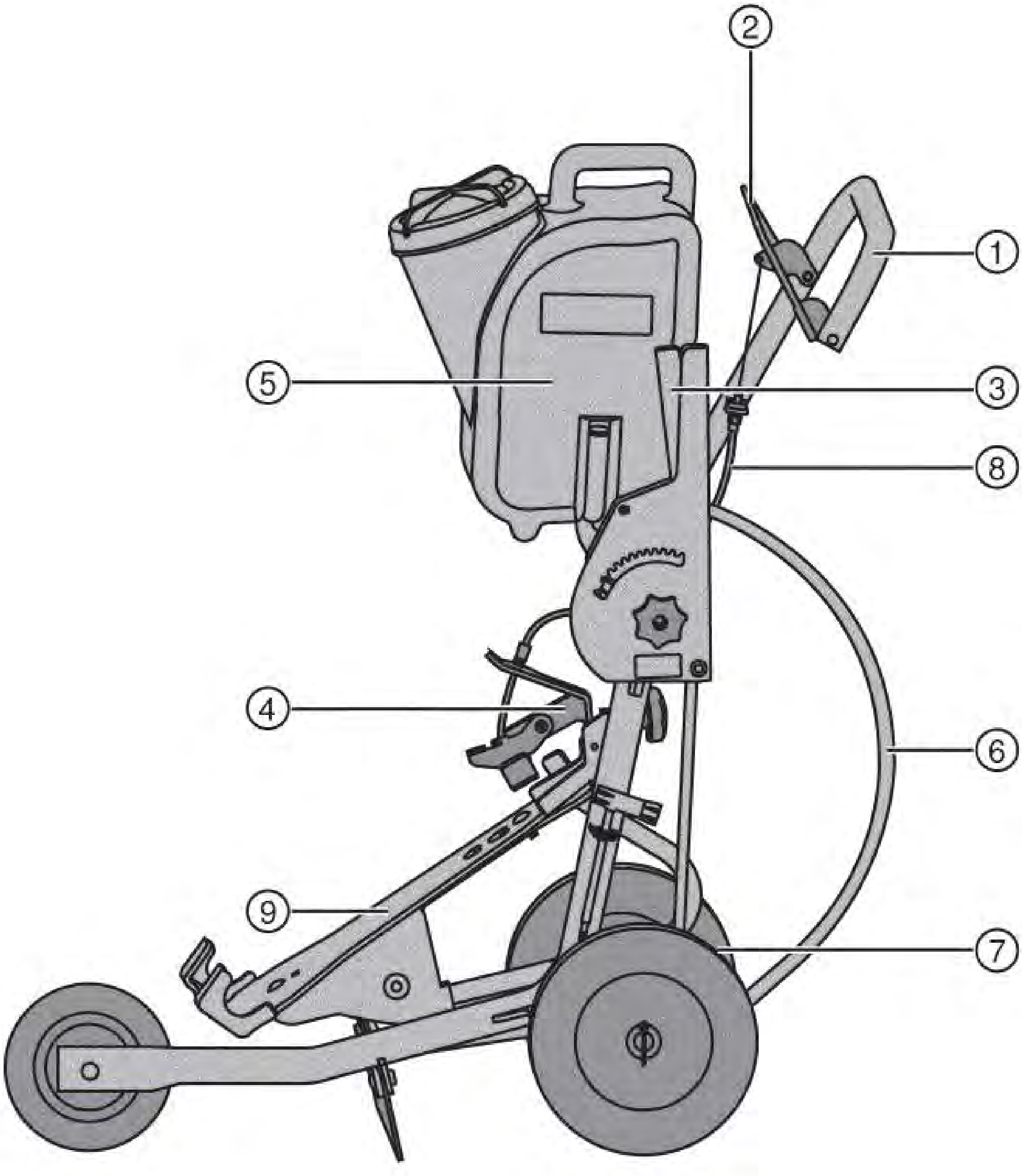

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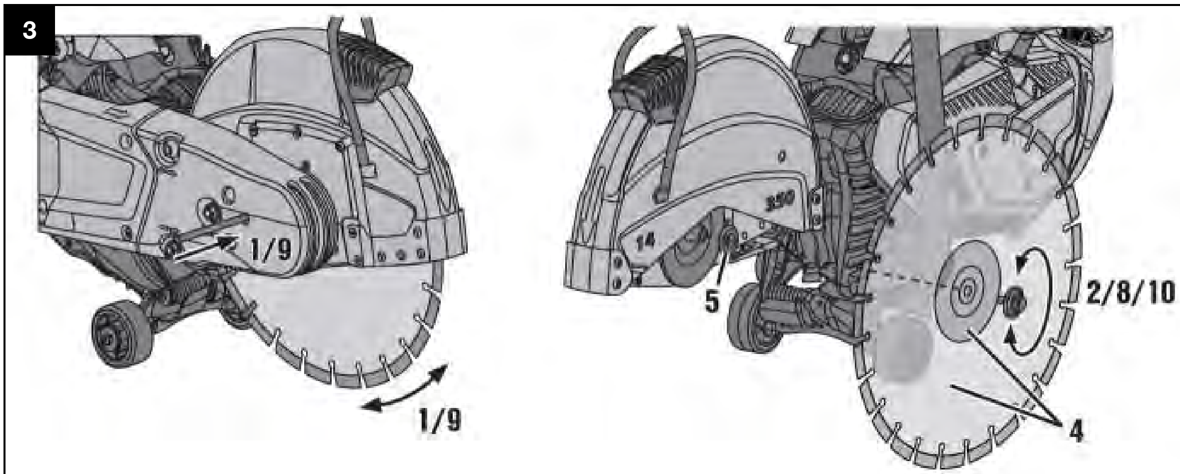

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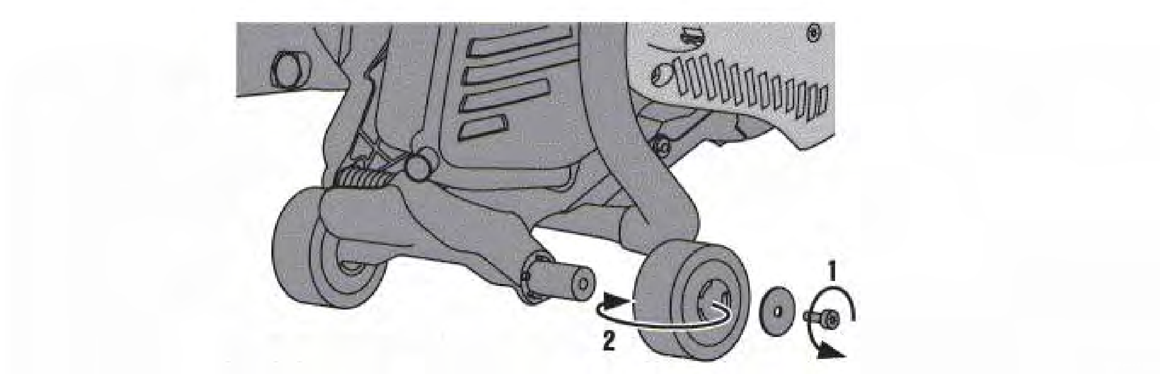

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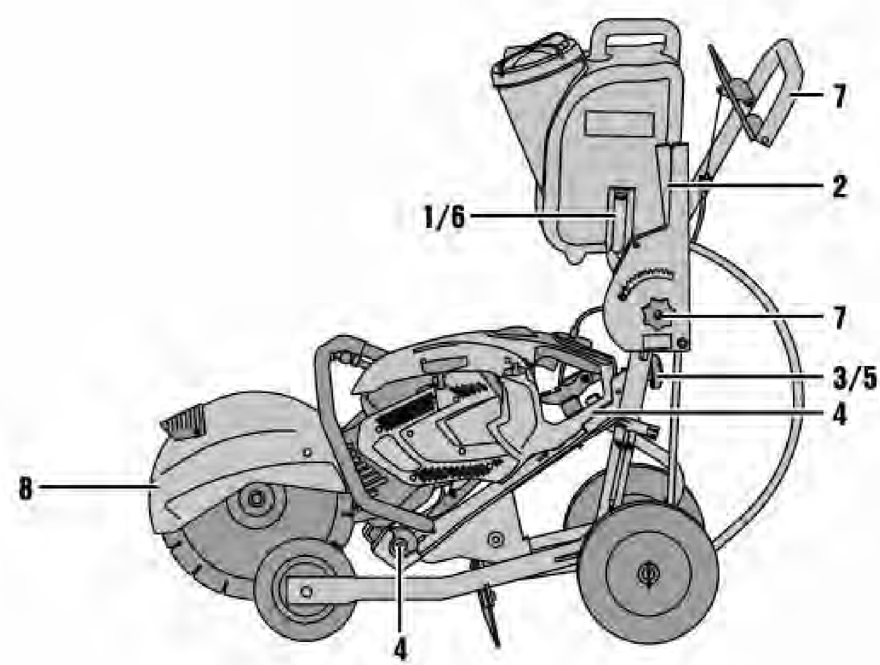

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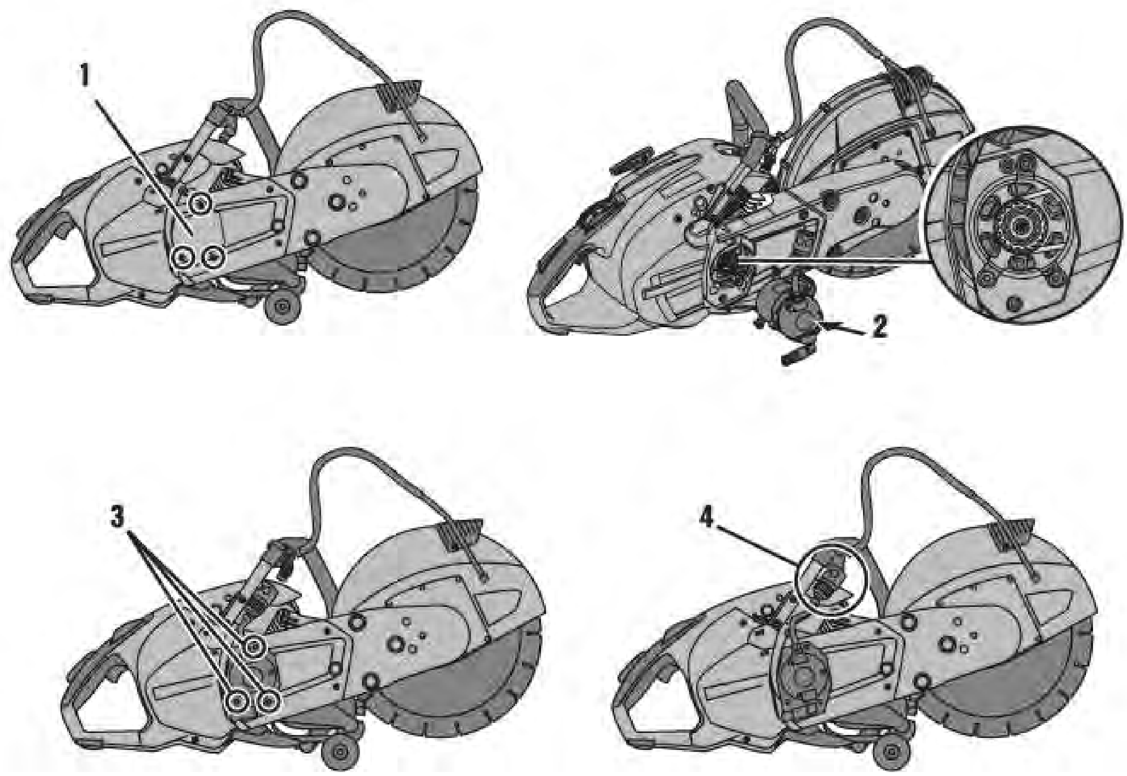

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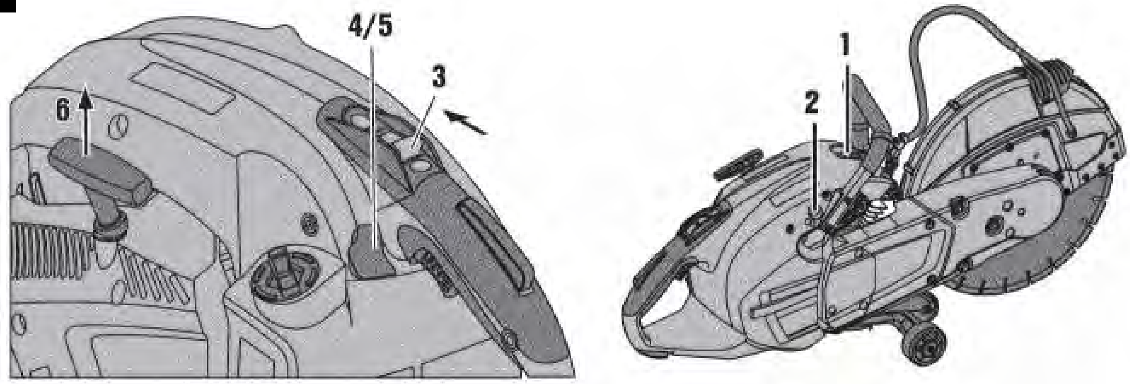

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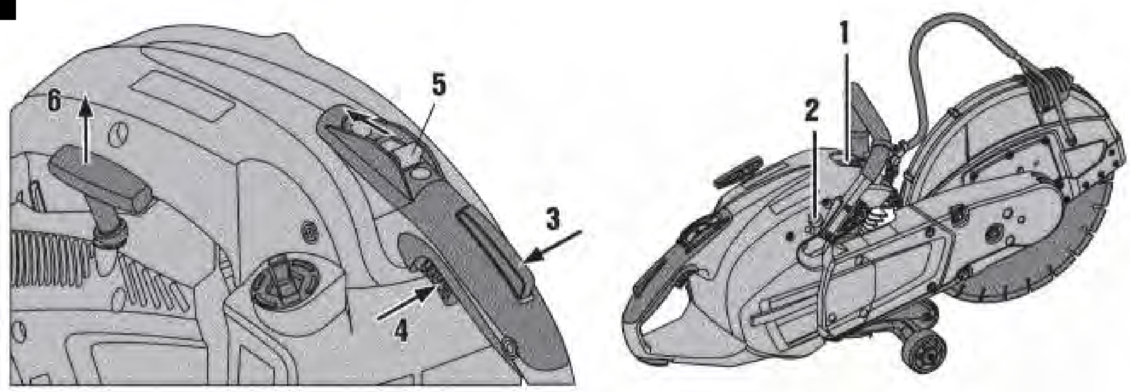

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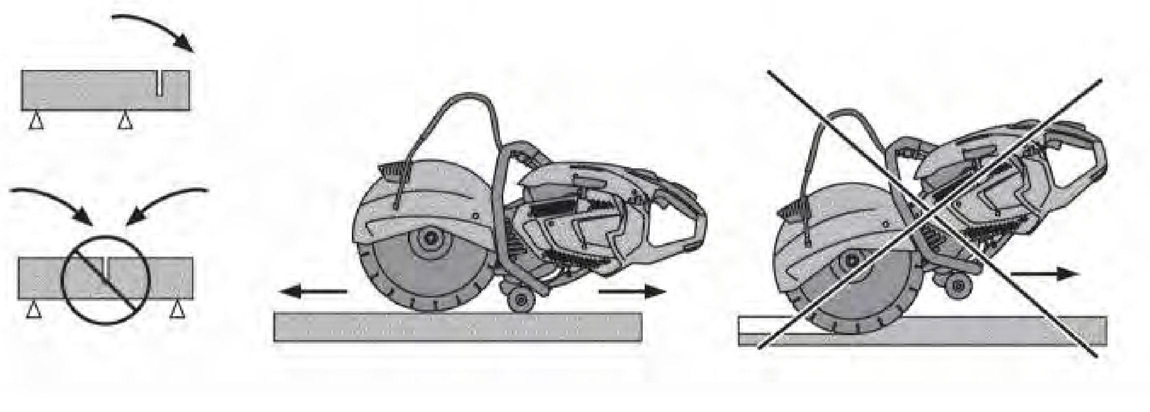

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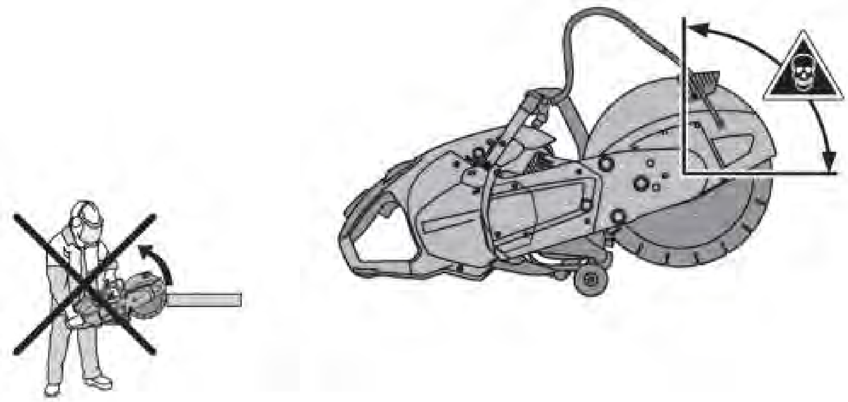

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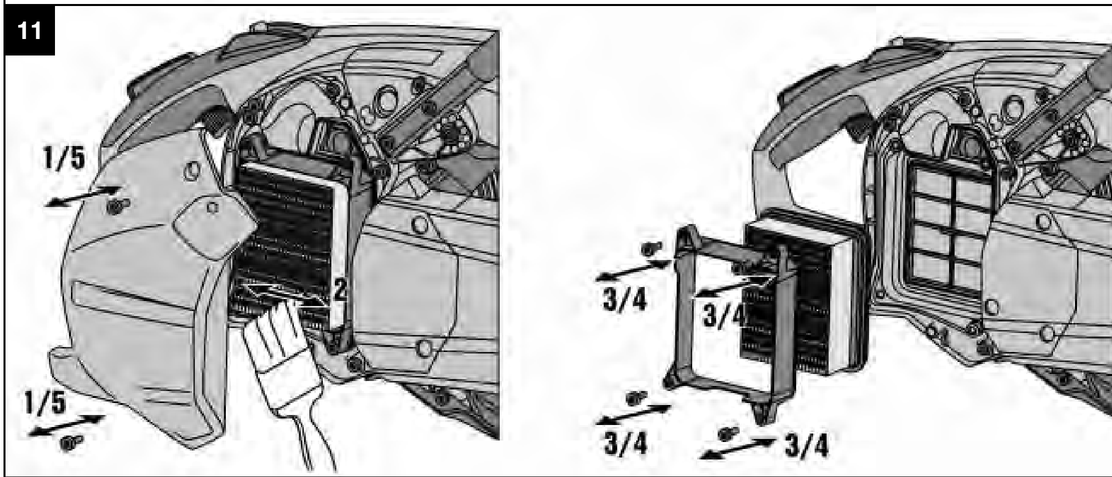

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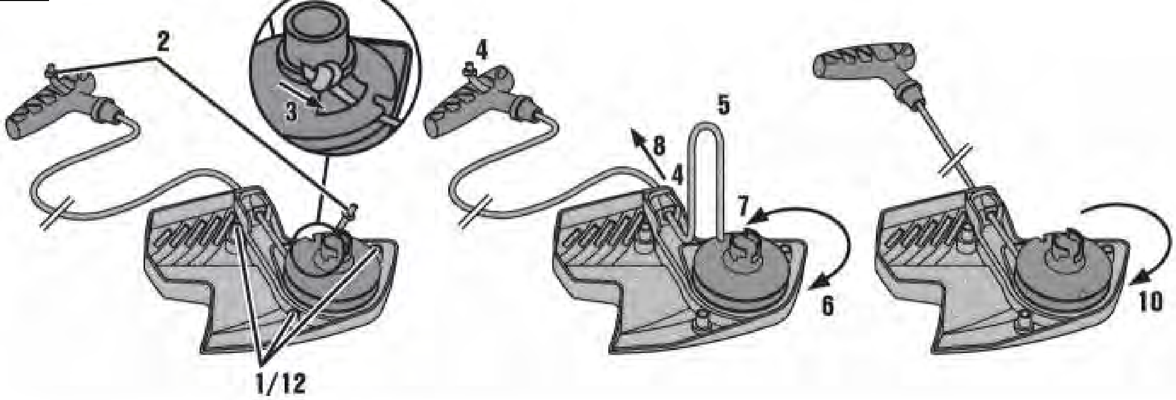

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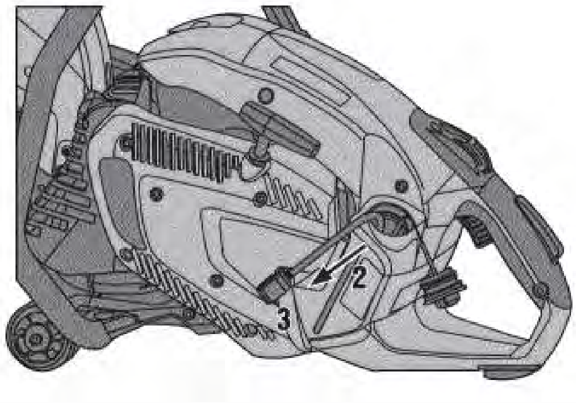

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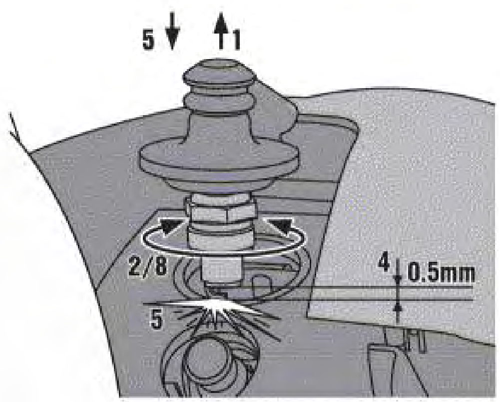

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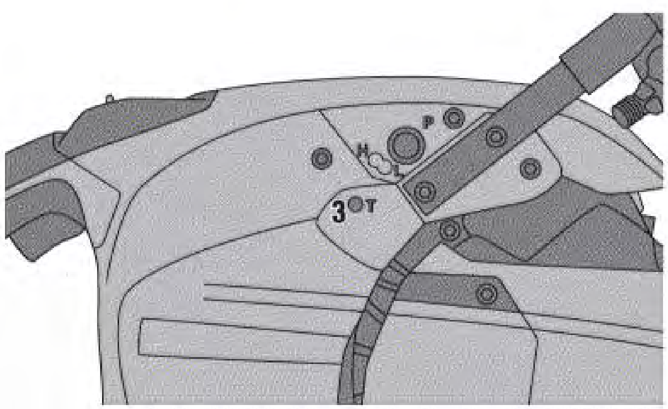


DSH 700

DSH 700-X

DSH 900

DSH 900-X

1 Information about the documentation

1.1 About this documentation

- Read this documentation before initial operation or use. This is a is a prerequisite for safe, trouble-free handling and use of the product.
- Observe the safety instructions and warnings in this documentation and on the product.
- Always keep the operating instructions with the product and make sure that the operating instructions are with the product when it is given to other persons.

1.2 Explanation of signs used

1.2.1 Warnings

Warnings alert persons to hazards that occur when handling or using the product. The following signal words are used in combination with a symbol:

	DANGER! Draws attention to imminent danger that will lead to serious personal injury or fatality.
	WARNING! Draws attention to a potentially dangerous situation that could lead to serious personal injury or fatality.
	CAUTION! Draws attention to a potentially dangerous situation that could lead to slight personal injury or damage to the equipment or other property.

1.2.2 Mandatory signs

The following mandatory signs are used:

	Wear ear protection, eye protection, respiratory protection and a hard hat.
	Wear protective gloves
	Wear safety shoes.

1.2.3 Symbols

The following symbols are used:

	Read the operating instructions before use.
	Instructions for use and other useful information
	Warning
	Rotation direction arrow on the guard
STOP	Engine stop position
	Engine run position
P	Primer bulb
H	Full-throttle jet adjusting screw
L	Idling jet adjusting screw
T	Idling adjusting screw
	Fuel mixture
	Fuel tank cap turning direction (to open)

|→|	Choke (only on DSH 700 or DSH 900)
½	Half throttle (only on DSH 700 or DSH 900)

1.2.4 Illustrations

The illustrations in these operating instructions are intended to convey a basic understanding and may differ from the actual version of the product:

2	These numbers refer to the illustrations at the beginning of the operating instructions.
3	The numbering in the illustrations reflects the order of the work steps in the illustration and may deviate from the numbering of work steps in the text.
(11)	Item reference numbers are used in the overview illustration. In the product overview section, the numbers shown in the legend relate to these item reference numbers.
	Points to which particular attention must be paid (in the illustrations)

1.3 Adhesive labels on the machine

Warning signs

	Warning: Flying sparks present a fire risk.
	Warning: Risk of kickback.
	Warning: Don’t inhale toxic vapors or exhaust fumes.
	Maximum arbor speed
	Warning: hot surface

Prohibition signs

	Don’t use toothed cutting discs.
	Don’t use damaged cutting discs.
	Smoking and naked flames prohibited.

1.4 Product information

Hilti products are designed for professional use and may be operated, serviced and maintained only by trained, authorized personnel. This personnel must be informed of any particular hazards that may be encountered. The product and its ancillary equipment may present hazards when used incorrectly by untrained personnel or when used not as directed.

▸ Make a note of the designation and serial number printed on the identification plate in the following table.

- Always quote this information when you contact a Hilti representative or Hilti Service regarding questions about the product:

Product information

Abrasive disc cut-off saw	DSH 700 | DSH 900
Generation:	01
Serial no.:	
Abrasive disc cut-off saw	DSH 700-X | DSH 900-X
Generation:	02
Serial no.:	

2 Safety

2.1 Safety instructions

In addition to the safety rules listed in the individual sections of these operating instructions, the following rules must be strictly observed at all times.

2.1.1 Personal safety

- Use the right machine for the job. Do not use the machine for purposes for which it was not intended. Use it only as directed and when in technically faultless condition.
- Never tamper with or modify the machine in any way.
- The product may be used only by persons who are familiar with it, who have been trained on how to use it safely and who understand the resulting hazards. The product is not intended for use by children.
- Stay alert, watch what you are doing and use common sense when working with the product. Do not use the product while you are tired or under the influence of drugs, alcohol or medication. A moment of inattention while operating the product may result in serious personal injury.
- The user and any other persons in the vicinity must wear ANSI Z87.1 approved protective glasses, a hard hat, ear protection, protective gloves, protective footwear and breathing protection while the machine is in use.
- Always hold the machine with both hands on the grips provided. Keep the grips dry, clean and free from oil and grease.
- Never use the machine without the guard (hood). Adjust the guard to the correct position. The guard must be securely attached and positioned for maximum safety, so that the smallest possible part of the cutting disc is exposed to the operator. Take steps to ensure that any sparks created while the product is in use do not present a hazard. The guard helps to protect the operator from broken disc fragments, accidental contact with the disc and uncontrolled flying sparks.
- Before using the product, or if an obstacle is contacted while the product is in use, check the guard immediately for possible damage. Damaged or broken guards must be replaced immediately.
- Avoid touching rotating parts – risk of injury!
- Keep proper footing and balance at all times. This will allow you to control the product better, even in unexpected situations, for example, in the event of experiencing kickback or rotational forces. Avoid unusual body positions.
- Dress properly. Do not wear loose clothing or jewelry. Keep your hair, clothing and gloves away from moving parts. Loose clothes, jewelry or long hair can be caught in moving parts.
- If the product or the cutting disc has been dropped or has fallen, check the product and the cutting disc for damage. Change the cutting disc if necessary.
- Switch the product off before adjusting the guard or changing the cutting disc.
- Wear protective gloves when changing the cutting disc. Touching the cutting disc presents a risk of injury (cuts or burns).
- Make sure you have a fire-extinguishing agent available as the possibility of flying sparks while working and the use of flammable fuel presents a risk of fire.
- Use of reducing sleeves is not permitted.
- Use of the wet cutting method is preferable in order to reduce the amount of dust produced when cutting mineral materials and asphalt.
- Avoid skin contact with the sawing slurry created when using the wet cutting method.
- Dust from material such as paint containing lead, some wood species, minerals and metal may be harmful. Contact with or inhalation of the dust may cause allergic reactions and/or respiratory diseases

among operators or bystanders. Material containing asbestos may be worked on only by specialists. To reduce the amount of dust produced when cutting, we recommend use of the wet cutting method. Ensure that the workplace is well ventilated. The use of a dust mask of filter class P2 is recommended. Follow national requirements for the materials you want to work with.

- Improve the blood circulation in your fingers by relaxing your hands and exercising your fingers during breaks between working. Exposure to vibration during long periods of work can lead to disorders of the blood vessels and nervous system in the fingers, hands and wrists.
- Consult the responsible structural engineer, architect or person in charge of the building project before beginning the work. Slits cut in load-bearing walls of buildings or other structures may influence the statics of the structure, especially when steel reinforcing bars or load-bearing components are cut through.
- Apply appropriate safety measures at the opposite side of the workpiece in work that involves breaking through. Pieces of debris could drop out and / or fall down and injure other persons.
- Never leave the product running while unattended. Switch the engine off and wait until the cutting disc has completely stopped rotating before placing the product on the ground or before transporting it.
- If the product is operated without an external water pump, it is essential that the pump cover is fitted.
- Switch the product off after use.
- Look after the product carefully. Check to ensure that no parts are broken or damaged in such a way that the product may no longer function correctly. If parts are damaged, have the parts replaced before use of the product.
- To reduce the risk of injury, use only genuine **Hilti** accessories and accessory tools.
- Have the product repaired only by qualified, skilled personnel, using only genuine Hilti spare parts. The safety of the product can thus be maintained.
- Observe the national health and safety requirements.

2.1.2 Electrical safety

- Before beginning work, check the working area for concealed electric cables or gas and water pipes. External metal parts of the machine may give you an electric shock if you damage an electric cable accidentally.

2.1.3 Safety at the workplace

- Ensure that the workplace is well lit.
- Don’t work in closed rooms. Carbon monoxide, unburned hydrocarbons and benzene in the exhaust gas may cause asphyxiation.
- Keep the workplace tidy. Objects which could cause injury should be removed from the working area. Untidiness at the workplace can lead to accidents.
- Hot exhaust gases containing sparks or sparks generated by the cutting operation may cause fire or explosion. Take care to ensure that the sparks generated do not ignite flammable (gasoline, dry grass, etc.) or explosive (gas, etc.) substances.
- Before fitting the water pump, check to ensure that the maximum permitted water supply pressure of 6 bar is not exceeded.
- Fit the filled water tank only after the saw has been mounted on the saw trolley. This will help to prevent the trolley falling over.
- Do not stand the product and the saw trolley on an inclined surface. Always check to ensure that the product and the saw trolley are standing securely.

2.1.4 Liquids (gasoline and oil) and vapors

- Allow the product to cool before refueling.
- Never smoke while refueling.
- Don’t refuel the product at the workplace area. When refueling, take care to avoid fuel spillage. Use a suitable funnel.
- Avoid inhaling gasoline vapors and exhaust fumes. Take care to ensure adequate ventilation.
- Don’t use the gasoline or other flammable liquids for cleaning.

2.1.5 Cutting work using cutting discs

- Use only cutting discs with a rated maximum permissible speed that’s at least as high as the highest spindle speed.
- Check that the outside diameter and the thickness of the cutting disc comply with the capacity rating of the product.

- Never use cutting discs that are damaged, run untrue or vibrate.
- Do not use damaged diamond cutting discs (cracks in the steel disc, broken or polished segments, damaged arbor hole, bent or distorted steel disc, heavy discoloration due to overheating, steel disc worn away beneath the segments, diamond segments with no lateral overhang, etc.).
- Do not use toothed accessory cutting tools (e.g. toothed saw blades).
- When fitting the cutting disc, always take care to ensure that the disc's specified direction of rotation corresponds to the direction of rotation of the spindle.
- The cutting disc and flange or any other accessory must fit the arbor of the product exactly. Cutting discs or accessories with arbor holes that do not match the mounting hardware of the product will run out of balance, vibrate excessively and may cause loss of control.
- Always use an undamaged clamping flange of the correct diameter which fits the cutting disc used. The correctly fitting clamping flange supports the cutting disc and thus reduces the possibility of disc breakage.
- Guide the product smoothly and do not apply lateral pressure to the cutting disc. Always bring the cutting disc into contact with the workpiece at right angles. Don't attempt to alter the line of cut by applying lateral pressure or by bending the cutting disc while cutting is in progress.
- Wear protective gloves when changing the cutting disc as the disc will get hot during use.
- Abrasive cutting discs which are used for wet cutting must be used up the same day as long periods of exposure to moisture have a negative effect on the strength of the disc.
- Observe the expiry date for resin-bonded cutting discs and don't use the discs after this date.

2.1.6 Transport and storage

- Switch the product off before transporting it.
- Remove the cutting disc from the product after use. The cutting disc may suffer damage during transport with the disc fitted.
- Handle the cutting disc carefully and store it in accordance with the manufacturer's instructions.
- Always store and transport the product in an upright position, not lying on its side.
- Do not carry the saw trolley and the product together. Remove the water tank before transporting the saw trolley.
- Do not lift the product and the saw trolley by crane. This is not permissible.
- Store the product in a secure place when not in use. Products which are not in use must be stored in a dry, high place or locked away out of reach of children.
- When laying the product down, make sure that it stands securely.
- After use, allow the product to cool down before packing it away or placing a cover over it.
- Store gasoline and oil in a well-ventilated room in fuel containers that comply with regulations.

3 Description

3.1 Overview of the product

3.1.1 Gasoline-powered cut-off saw 1

① Hood
② Water supply
③ Forward grip
④ Water valve
⑤ Starter handle
⑥ Fuel tank cap
⑦ Choke lever / half-throttle lock (DSH 700 OR DSH 900)
⑧ Throttle trigger
⑨ Rear grip
⑩ Rating plate
⑪ Fuel gauge
⑫ Guide wheels
⑬ Cutting disc
⑭ Clamping screw
⑮ Clamping flange
⑯ Spark plug connector
⑰ Decompression valve
⑱ Throttle safety grip
⑲ Start/stop switch (DSH 700 OR DSH 900)
⑲ Start/stop switch with integrated half-throttle lock (DSH 700-X OR DSH 900-X)
⑳ Primer bulb
㉑ Water connection
㉒ Grip for guard adjustment
㉓ Blade rotation direction (arrow in front part of guard)
㉔ Saw arm
㉕ Hole for locking pin for changing cutting discs
㉖ Pump cover
㉗ Air filter cover

3.1.2 Saw trolley (accessory) 2

① Grip
② Throttle trigger
③ Cutting depth adjustment
④ Hold-down device
⑤ Water tank
⑥ Water connection
⑦ Axial adjustment
⑧ Throttle cable
⑨ Machine cradle

3.2 Intended use

The product described is a gasoline-powered cut-off saw for the wet or dry cutting of asphalt, mineral construction materials or metals using diamond cutting discs or abrasive cutting discs. It can be held and guided by hand or mounted on a saw trolley.

The saw is not suitable for use in environments where there is risk of fire or explosion.

3.3 Recommendations for use

We recommend:

- Use of the wet cutting method is preferable in order to reduce the amount of dust produced when cutting. By using the self-priming water pump (accessory) you can work without need for a water supply pipe. The water can be drawn, for example, directly from a container.
- Do not cut right through the workpiece in one pass. Move the saw back and forward several times until it gradually reaches the desired cutting depth.
- To avoid damaging the diamond cutting disc when dry cutting, lift the disc out of the cut for approx. 10 seconds every 30 to 60 seconds while the product is still running.
- Resharpen polished diamond segments (no diamonds project from the segment matrix) by cutting with the disc in a very abrasive material such as sandstone.
- For extensive floor sawing applications, mount the saw on the trolley (accessory).

3.4 Cutting disc specifications

Diamond cutting discs in accordance with ANSI B7.1 are to be used with the product. Synthetic resin-bonded, fiber-reinforced cutting discs in accordance with ANSI B7.1 (straight, not dish-shaped, type cutting-off wheel) may also be used with the product for working on metals.

The disc mounting instructions and instructions for use issued by the cutting disc manufacturer must be observed.

3.5 Items supplied

Gasoline-powered saw, DSH tool set, DSH consumables set (only with the DSH 700-X/900-X), operating instructions.

You can find other system products approved for your product at your local **Hilti** Center or online at: **www.hilti.com**

3.6 Consumables and wearing parts

- Air filter
- Cord (5 pcs)
- Starter
- Fuel filter
- Spark plug
- Tool set
- Cylinder set
- Mounting screw assy.
- Flange (2)
- Centering ring 20 mm / 1"

4 Technical data

4.1 Gasoline-powered cut-off saw

	DSH 700 30/12" / DSH 700-X 30/12"	DSH 700 35/14" / DSH 700-X 35/14"	DSH 900 35/14" / DSH 900-X 35/14"	DSH 900 40/16" / DSH 900-X 40/16"
Cubic capacity	4.19 in³ (68.7 cm³)	4.19 in³ (68.7 cm³)	5.3 in³ (87 cm³)	5.3 in³ (87 cm³)
Weight without cutting disc, tank empty	25.6 lb (11.6 kg)	26.0 lb (11.8 kg)	26.5 lb (12.0 kg)	26.9 lb (12.2 kg)
Weight with saw carriage, without cutting disc, tank empty	93.9 lb (42.6 kg)	94.4 lb (42.8 kg)	94.8 lb (43.0 kg)	95.2 lb (43.2 kg)
Power rating	4.7 hp (3.5 kW)	4.7 hp (3.5 kW)	5.8 hp (4.3 kW)	5.8 hp (4.3 kW)
Maximum arbor speed	5,100 /min	5,100 /min	5,100 /min	4,700 /min
Maximum cutting depth	3.9 in (100 mm)	4.9 in (125 mm)	4.9 in (125 mm)	5.9 in (150 mm)

4.2 Additional technical data

Engine type	Single-cylinder, air-cooled two-stroke engine
Engine speed	9500 ± 200 /min
No-load speed	2,500 /min ... 3,000 /min
Ignition (type)	Electronically-controlled ignition timing
Electrode gap	0.02 in (0.5 mm)
Spark plug	Manufacturer: NGK, type: CMR7A-5
Tightening torque for fitting the spark plug	9 $ftlb_f$ (12 Nm)
DSH 700/900 carburetor	Manufacturer: Walbro; model: WT; type: 895
DSH 700-X/900-X carburetor	Manufacturer: Walbro; model: WT; type: 1152
Fuel mixture	API-TC oil 2% (1:50)
Tank capacity	54.9 in³ (900 cm³)
Cutting disc arbor size / diameter of centering bush	0.8 in (20 mm)
Cutting disc arbor size / diameter of centering bush	1.00 in (25.4 mm)
Minimum flange outside diameter	4.0 in (102 mm)
Max. disc thickness (steel disc thickness)	0.22 in (5.5 mm)
Tightening torque for fitting the cutting disc	18 $ftlb_f$ (25 Nm)

5 Before use

5.1 Fuel

The two-stroke engine runs on a mixture of gasoline and oil. The quality of the fuel mixture decisively influences the running and life expectancy of the engine.

DANGER

Risk of fire and explosion. Gasoline vapors are highly flammable.

- Never smoke while refueling.
- Don't refuel the product at the area where you are working (move at least 3 meters (10 feet) away from the working area).
- Don't refuel the product while the engine is running. Wait until the engine has cooled down.
- Make sure there are no naked flames or sparks that could ignite the gasoline vapors.
- Take care to avoid fuel spillage. If fuel is spilled, clean up the areas affected immediately.
- Check to ensure there is no leakage from the fuel tank.

CAUTION

Risk of injury. The inhalation of gasoline vapors and skin contact with gasoline may be hazardous to the health.

- Avoid direct skin contact with gasoline. Wear protective gloves.
- If your clothing becomes soiled with gasoline, it is essential to change your clothing.
- Ensure that the workplace is well ventilated in order to avoid breathing in gasoline fumes.
- Use a fuel container that complies with the applicable regulations.

Note

Alkylate gasoline does not have the same density (specific weight) as conventional gasoline. To avoid damage when alkylate gasoline is used, the engine settings must be readjusted by **Hilti** Service. Alternatively, the oil content can be increased to 4% (1:25).

5.1.1 Using two-stroke oil

- Use good-quality, two-stroke oil for air-cooled engines that meets at least the API-TC specification.

5.1.2 Gasoline

- Use regular or super gasoline with an octane rating of at least 89 ROZ.

Note

The alcohol content (e.g. ethanol, methanol or others) of the fuel used must not exceed 10%, otherwise the life expectancy of the engine will be greatly reduced.

5.1.3 Mixing fuel

Note

The engine will suffer damage if run with fuel mixed in the wrong ratio or with unsuitable oil.

Use a mixing ratio of 1:50. This corresponds to 1 part good-quality two-stroke oil that complies with the API-TC specification and 50 parts gasoline (e.g. 100 ml oil and 5 liters of gasoline mixed in a suitable canister).

1. Pour the required quantity of two-stroke oil into the fuel canister.
2. Then fill the gasoline into the fuel canister.
3. Close the fuel canister.
4. Mix the fuel by shaking the fuel container.

Note

If the quality of the two-stroke oil or the gasoline is unknown, then increase the mixing ratio to 1:25.

5.1.4 Filling the fuel tank

1. Mix the fuel (two-stroke oil / gasoline mixture) by shaking the fuel container.
2. Place the product in a steady upright position.
3. Open the fuel tank by turning the cap counterclockwise and then removing the cap.
4. Fill the tank slowly using a funnel.
5. Close the fuel tank by fitting the cap and then turning it clockwise.
6. Close the fuel canister.

5.2 Assembly and adjustment

WARNING
Risk of injury. Contact with the rotating cutting disc can lead to injury. Hot parts of the machine or a hot cutting disc may cause burning injuries.

- Before fitting or adjusting any parts of the product, make sure that the engine is switched off, that the cutting disc has completely stopped rotating and that the product has cooled down.
- Wear protective gloves.

5.2.1 Fitting a cutting disc 3

CAUTION
Risk of injury and damage. Damaged cutting discs may break.

- Never use cutting discs that are damaged, run untrue or vibrate.
- Don't use synthetic resin-bonded fiber-reinforced cutting discs which have exceeded their use-by date or already softened due to water absorption.

CAUTION
Risk of injury and damage. Cutting discs or fastening parts that don't fit correctly can suffer irreparable damage or lead to loss of control of the product.

- Use only cutting discs with a rated maximum permissible speed that's at least as high as the maximum speed stated on the product. The cutting discs, flanges and screws used must fit the product.
- Use only cutting discs with an arbor size (mounting hole diameter) of 20 mm or 25.4 mm (1").

1. Insert the locking pin in the hole in the drive belt cover and turn the cutting disc until the locking pin engages.
2. Release the securing screw by turning the screw counterclockwise with the wrench and then remove the screw and washer.
3. Remove the locking pin.
4. Remove the clamping flange and the cutting disc.
5. Check that the mounting bore of the cutting disc to be fitted corresponds with the centering collar of the cutting disc mounting flange.

   Note
   The mounting flange is equipped with a 20 mm diameter centering collar on one side and a 25.4 mm (1") diameter centering collar on the opposite side.

6. Clean the clamping and centering surfaces on the product and on the cutting disc.
7. Place the cutting disc with centering collar on the drive arbor and check that the direction of rotation is correct.
   ◃ The direction-of-rotation arrow on the cutting disc must match the direction of rotation indicated on the product.
8. Place the clamping flange and washer on the drive arbor and tighten the securing screw by turning it clockwise.
9. Insert the locking pin in the locking hole in the drive belt cover and turn the cutting disc until the locking pin engages.
10. Tighten the clamping screw securely (tightening torque: 25 Nm).
11. Remove the locking pin.

   Note
   After fitting a new cutting disc allow the product to run at full speed under no load for approx. 1 minute.

5.2.2 Adjusting the guard

DANGER
Risk of injury. Flying fragments or sparks could cause injury.

- Adjust the guard so that flying particles or fragments of the material removed and flying sparks are directed away from the operator and the product.

- Hold the guard by the grip provided and rotate it to the desired position.

5.2.3 Conversion from normal cutting to flush cutting

Note
The front section of the saw arm can be converted to allow flush cuts to be made (e.g. as close as possible to edges and walls).

- If you wish to use the product in the flush cutting position, have the product converted by **Hilti** Service.

5.3 Locking rotary movement of the guide wheels 4

WARNING
Risk of injury. The saw could move inadvertently or fall down.

- When working on roofs, scaffolds and/or on slightly sloping ground or surfaces, always take steps to prevent rotation of the guide wheels when the saw is not in use.

1. Release the guide wheel mounting screws and remove the guide wheels.
2. Reverse the guide wheels (turn through 180°) and refit the mounting screws.
   ◃ The integrated locking function is active.
3. Check that the guide wheels are securely fastened.

5.4 Mounting the gasoline-powered saw on the saw trolley (accessory) 5

1. Remove the water tank from the saw trolley.
2. Move the cutting depth adjustment lever into the upper position.
3. Open the hold-down device by releasing the screw knob.
4. Fit the saw into the forward mount with the wheels as shown and swing the grip of the saw under the hold-down device.
5. Secure the saw by tightening the screw knob.
6. Fit the water tank after filling it.
7. Adjust the grip to a convenient working height.
8. Adjust the guard to the correct position. → page 10

Note
Especially when using the machine in this configuration for the first time, check to ensure that the throttle cable is correctly adjusted. When the throttle trigger is pressed fully, the product must run up to maximum speed. If this is not the case, the throttle cable can be readjusted by way of the cable tensioner.
When the throttle is not actuated, the engine must be idling and the cutting disc must not rotate. If this is not the case, switch off by pushing the start/stop switch to the “stop” position and then adjust the throttle cable or have the idling speed adjusted by **Hilti** Service.

5.5 Fitting the water pump (accessory) 6

1. Release the three pump cover retaining screws, remove the parts and store the pump cover in a safe place.

   Note
   The pump cover must be fitted if the product is used without the water pump.

2. Bring the water pump into place while rotating the cutting disc slightly until the toothing on the water pump and inside the clutch housing match and the teeth mesh correctly.
   ◃ The position is keyed so it is not possible to position the pump incorrectly.
3. Fit the three retaining screws and tighten them securely (tightening torque: 4 Nm).

4. Connect the pump hose to the hose connector on the saw.
5. Connect the water pump to the water supply or hang the suction hose in a container filled with water.

Note
The maximum permitted water supply pressure is 6 bar.

5.6 Removing the water pump (accessory)

1. Disconnect the water supply from the water pump.
2. Disconnect the connector between the pump and the product.
3. Release the three fastening screws on the pump and then remove the pump.
4. Fit the pump cover on the product, insert the three retaining screws and tighten the screws securely (tightening torque: 4 Nm).

6 Operation

6.1 Starting the engine

DANGER
Risk of asphyxiation. Carbon monoxide, unburned hydrocarbons and benzene in the exhaust gas may cause asphyxiation.

- Don't work in closed rooms, trenches or pits and make sure the area is well ventilated.

WARNING
Risk of burning injury. The exhaust system gets extremely hot when the engine is running. It stays hot for a long time after the engine is switched off.

- Wear protective gloves and avoid touching the exhaust system.
- Do not lay the product down on flammable material while hot.

WARNING
Risk of injury. A damaged exhaust system will raise the noise level above the permissible limit and thus cause hearing damage.

- Never use the product if the exhaust system is damaged, missing or if it has been tampered with.

6.1.1 Starting the engine 7

~~DSH 700~~
~~DSH 900~~

1. Press the decompression valve (once).
2. Squeeze the primer bulb 2 to 3 times until the primer bulb is completely filled with fuel.
3. Move the start/stop switch to the "start" position.
4. Select one of the following alternatives. This action includes 2 alternatives.
   Alternative 1 / 2
   - If the motor is cold, pull the choke lever upwards.
     - ◃ The choke and half throttle are engaged.

   Alternative 2 / 2
   - If the motor is hot, pull the choke lever up and then push it back down.
     - ◃ Half throttle is engaged, the choke is not engaged.
5. Check that the cutting disc is free to rotate.
6. Position your right foot over the lower part of the rear grip.
7. Pull the starter handle slowly with your right hand until resistance is felt.
8. Pull the starter handle vigorously.
9. When the motor fires for the first time (after 2 to 5 pulls of the starter), move the choke lever back down to its original position.
10. Pull the starter handle vigorously and repeat this action until the engine starts.

Note

The motor will flood if the starting procedure is repeated too many times with the choke engaged.

11. Press the throttle trigger briefly as soon as the engine starts.
    - ◃ This disengages the half-throttle position and the engine then runs at idling speed when the throttle is released.

6.1.2 Starting the engine 8

DSH 700-X
DSH 900-X

1. Press the decompression valve (once).
2. When starting the cold engine (only when cold), squeeze the primer bulb 2 to 3 times (until the primer bulb is completely filled with fuel).
3. Press the throttle safety grip and keep it pressed.
4. Press the throttle trigger and keep it pressed.
5. Move the start/stop switch to the “start” position.
6. Release the throttle safety grip and throttle trigger.
    - ◃ This half-throttle position is activated.
7. Check that the cutting disc is free to rotate.
8. Position your right foot over the lower part of the rear grip.
9. Pull the starter handle slowly with your right hand until resistance is felt.
10. Pull the starter handle vigorously.
11. Repeat this action until the engine starts.
12. Press the throttle trigger briefly as soon as the engine starts.
    - ◃ This disengages the half-throttle position and the engine then runs at idling speed when the throttle is released.

6.2 Checks after starting the engine

1. Check that the cutting disc remains stationary when the engine is idling and, after briefly running at full speed, that the disc again comes to a complete standstill.
    - ◃ Readjust (reduce) the idling speed if the cutting disc doesn’t stop rotating when the engine is idling. If this is not possible, please bring the product to **Hilti** Service.
2. Check that the start/stop switch is functioning correctly. Move the start/stop switch to the “stop” position.

DSH 700
DSH 900

- ▸ If the engine doesn’t stop, push the choke lever upwards. If the engine still doesn’t stop, pull the spark plug connector off the spark plug and bring the product to **Hilti** Service.

DSH 700-X
DSH 900-X

- ▸ If the engine doesn’t stop, compress the primer bulb. If the engine still doesn’t stop, pull the spark plug connector off the spark plug and bring the product to **Hilti** Service.

6.3 Switching the engine off

WARNING

Risk of injury. A rotating cutting disc can break or shatter, possibly resulting in flying fragments.

- ▸ Allow the rotating cutting disc to come to a complete standstill before you lay the saw down.

1. Release the throttle trigger.
2. Move the start/stop switch to the “stop” position.
    - ◃ The engine stops.

6.4 Cutting techniques

In order to work optimally with this product, the following safety instructions must be observed:

- Always hold the product and the saw trolley with both hands on the grips provided. Keep the grips dry, clean and free from oil and grease.

- Before beginning the work, or if an obstacle was previously inadvertently contacted, check the cutting disc and guard immediately for possible damage.
- Check that no persons are present in the working area and, in particular, in the direction in which the cut is to be made. Keep other persons approx. 15 m away from your workplace.
- Guide the product smoothly and do not apply lateral pressure to the cutting disc.
- Always bring the cutting disc into contact with the workpiece at right angles. Don't attempt to alter the line of cut by applying lateral pressure or by bending the cutting disc while cutting is in progress.
- Secure the workpiece. Use clamps or a vice to hold the workpiece in position. The workpiece is thus held more securely than by hand and both hands remain free to operate the product.
- Secure the workpiece and the part to be cut off in order to prevent uncontrolled movement.

- ▸ When working with the saw trolley, check before use that the gasoline-powered saw is mounted correctly on the saw trolley.
- ▸ Switch the gasoline-powered saw off immediately at the start/stop switch in the event of the saw trolley throttle cable sticking or if the throttle trigger sticks.
- ▸ Always apply full throttle when cutting.

6.4.1 Avoiding stalling 9

CAUTION

Risk of disc breakage or kickback. Application of excessive pressure causes distortion of the cutting disc. Sticking or stalling of the cutting disc increases the probability of kickback or disc breakage.

- ▸ Avoid applying excessive pressure when cutting and don't allow the cutting disc to stick and stall.
- ▸ Don't attempt to make an excessively deep cut.

1. Cutting through thick workpieces should be accomplished, as far as possible, by making a several cuts. Avoid making excessively deep cuts.
2. Support slabs or large workpieces so that the kerf remains open during and after the cutting operation.

6.4.2 Avoiding kickback 10

1. Always bring the cutting disc into contact with the workpiece from above.
   ◃ Allow the cutting disc to contact the workpiece only at a point below its rotational axis.
2. Take special care when inserting the cutting disc in an existing kerf.

7 Care and maintenance

WARNING

Risk of injury. Touching the rotating cutting disc or hot parts of the machine may lead to injury or burns.

- ▸ Switch the engine off and allow the product to cool down before all maintenance, repairs, cleaning or servicing.

7.1 Maintenance

7.1.1 Before use

1. Check that the product is complete, not leaking and that it is in faultless condition. Repair it if necessary.
2. Check that the product is not dirty and clean it if necessary.
3. Check that the operating controls function correctly. Have them repaired if necessary.
4. Check that the cutting disc is in faultless condition and replace it if necessary.
5. Check the tightness of all externally accessible screws and nuts and retighten them if necessary.

7.1.2 Every 6 months

1. Check the tightness of all externally accessible screws and nuts and retighten them if necessary.
2. Check the fuel filter for dirt or clogging and replace it if necessary.

7.1.3 If necessary

1. Check the tightness of all externally accessible screws and nuts and retighten them if necessary.
2. Change the air filter if the engine fails to start or if its performance drops noticeably.
3. Check fuel filter for dirt or clogging and replace it if necessary.

4. Clean the spark plug, or replace it if necessary, if the product doesn't start or starts only with difficulty.
5. Readjust (reduce) the idling speed if the cutting disc doesn't stop rotating when the engine is idling.
6. Have the product repaired by **Hilti** Service if the drive belt slips when a load is applied to the cutting disc.

7.2 Cleaning or replacing the air filter 11

Risk of damage. Entry of dust causes irreparable damage to the product.

- Never operate the machine if the air filter is damaged or missing.
- When changing the air filter, the product should stand upright and should not be laid on its side. Take care to ensure that no dust finds its way onto the underlying filter screen.

Note
Change the air filter if engine performance drops noticeably or if the engine becomes difficult to start.

1. Release the securing screw on the air filter cover and remove the cover.
2. Carefully remove the dust adhering to the air filter and the filter chamber (use a vacuum cleaner).
3. Release the four screws retaining the filter holder and remove the air filter.
4. Fit the new filter and secure it with the filter holder.
5. Fit the air filter cover and tighten the retaining screws.

7.3 Replacing a broken starter cord 12

CAUTION
Risk of damage. The housing may suffer damage if the starter cord is too short.

- Never continue to use a broken starter cord. Replace it immediately.

1. Unscrew the three securing screws and remove the starter assembly.
2. Remove the remaining pieces of the starter cord from the spool and the starter handle.
3. Make a secure knot in the end of the replacement starter cord and then pass the free end of the cord through the hole in the spool from above.
4. Pass the end of the cord through the opening in the starter housing from below, also through the starter handle from below, and then make a secure knot in the end of the cord.
5. Pull a length of the starter cord out of the housing as shown in the illustration and pass it through the slot in the spool.
6. Hold the cord securely close to the slot in the spool and then rotate the spool in a clockwise direction as far as it will go.
7. Rotate the spool back from its end point at least a ½ revolution, max. 1 ½ revolutions, until the slot in the spool is in alignment with the opening in the starter housing.
8. Hold the spool securely and pull the free end of the cord out of the housing towards the starter handle.
9. Hold the cord under tension, release the spool and allow the starter cord to be pulled in.
10. Pull the starter cord out as far as it will go and check to ensure that the spool can be turned by hand at least a further ½ turn in a clockwise direction. If this is not possible, spring tension must be reduced by one revolution in a counterclockwise direction.
11. Fit the starter assembly and press it down gently. Pull the starter cord slightly until the coupling engages and the starter assembly is fully seated.
12. Secure the starter assembly with the three retaining screws.

7.4 Replacing the fuel filter 13

Note
When refueling the product, take care to ensure that no dirt or foreign matter finds its way into the fuel tank.

1. Remove the cap from the fuel tank.
2. Pull the fuel filter out of the fuel tank.
3. Check the condition of the fuel filter.
   - ◃ Replace the fuel filter if it is very dirty or clogged.
4. Slide back the clip on the hose and remove the dirty fuel filter.

5. Fit a new fuel filter and secure it with the clip on the hose.
6. Push the fuel filter back into the fuel tank.
7. Close the fuel tank.

7.5 Cleaning the spark plug, setting the spark plug gap or replacing the spark plug 14

CAUTION
Risk of injury. The spark plug and parts of the engine may be hot immediately after the product has been in use.

- Wear protective gloves and allow the product to cool down.

1. Use a gentle twisting motion to pull the cable connector off the spark plug.
2. Use the spark plug wrench to unscrew and remove the spark plug from the cylinder.
3. If necessary, clean the spark plug electrode with a soft wire brush.
4. Check the spark plug gap with the aid of a feeler gauge and, if necessary, reset it to the correct gap (0.5 mm).
5. Fit the ignition cable connector to the spark plug and hold the threaded section of the spark plug against the cylinder.
6. Move the start/stop switch to the “start” position.

WARNING
Risk of injury. Touching the electrodes presents a risk of electric shock.

- Don’t touch the spark plug electrodes.

7. Pull the starter cord (press the decompression valve first).
   - An ignition spark must now be clearly visible.
8. Use the spark plug wrench to screw the spark plug into the cylinder (tightening torque: 12 Nm).
9. Fit the ignition cable connector to the spark plug.

7.6 Adjusting the carburetor 15

The carburetor of this product has been factory set for optimum performance and sealed to prevent tampering (jets H and L). The idling speed of the machine (jet T) may be adjusted by the user. All other adjustments must be carried out by **Hilti** Service.

Note
Tampering with the carburetor settings may cause damage to the engine.

- Clean the air filter. → page 14
- Allow the product to run until it reaches its normal operating temperature.
- Use a suitable flat screwdriver (tip width 4 mm/ 5/32 ") and do not force the adjusting screw beyond its intended adjustment range.
- Adjust the idling speed jet (T) so that the engine runs smoothly when idling but the cutting disc does not begin to rotate.

7.7 Care and maintenance of the machine

Note
To help ensure safe and reliable operation, use only genuine Hilti spare parts and consumables. Spare parts, consumables and accessories approved by us for use with the product can be found at your local **Hilti** Center or online at: **www.hilti.com**

- Keep the product, especially its grip surfaces, clean and free from oil and grease.
- Do not use cleaning agents containing silicone.
- Clean the outer surfaces of the machine at regular intervals with a slightly damp cloth or a dry brush. Do not use a spray, steam pressure cleaning equipment or running water for cleaning.
- Do not allow foreign objects to enter the interior of the product.

7.8 Maintenance

1. Check all external parts of the product and the accessories for damage at regular intervals and check that all controls operate faultlessly.
2. Do not use the product if parts are damaged or if operating controls do not function faultlessly. Have the product repaired by **Hilti** Service.

7.9 Checks after care and maintenance work

- After carrying out care and maintenance, check that all protective and safety devices are fitted and that they function faultlessly.

8 Transport and storage

8.1 Transportation in a vehicle

DANGER
Risk of fire and explosion. If the product tips over during transport, fuel may run out of the fuel tank.

- Empty the product's fuel tank completely before packing and shipping it.
- Transport the product, as far as possible, in its original packaging.

WARNING
Fire hazard. Hot parts of the machine could ignite material lying about in the surrounding area.

- Allow the product to cool down completely before packing it away or loading it into a vehicle..

1. Remove the cutting disc.
2. Secure the product to prevent it falling over, thereby causing damage or fuel spillage.
3. Transport the saw trolley only when the water tank has been emptied.

8.2 Storing the fuel mixture

CAUTION
Risk of injury. As pressure may build up in the fuel tank there is a risk of fuel being forced out when the fuel cap is opened.

- Accordingly, take care when opening the cap on the fuel tank.
- Store the fuel in a dry, well-ventilated room.

1. Mix only enough fuel for a few days' use.
2. Clean the fuel container occasionally.

9 Troubleshooting

If the trouble you are experiencing isn't listed in this table or you are unable to remedy the problem by yourself, please contact **Hilti** Service.

Trouble or fault	Possible cause	Action to be taken
Cutting disc slows down or stops completely while cutting	Excessive cutting pressure applied (cutting disc sticks and stalls in the kerf).	▸ Reduce pressure when cutting and guide the product in a straight line.
	The cutting disc is not correctly fitted and tightened.	▸ Check how it is fitted and the tightening torque.
	Wrong direction of rotation.	▸ Fit the cutting disc. → page 9
	The forward section of the saw arm is loose.	▸ Have the product repaired by **Hilti** Service.
High vibration, disc wanders off the cutting line.	The cutting disc is not correctly fitted and tightened.	▸ Check how it is fitted and the tightening torque.

Trouble or fault	Possible cause	Action to be taken
High vibration, disc wanders off the cutting line.	Cutting disc is damaged (or unsuitable specification, cracked, segments missing, bent, overheated, deformed, etc.).	▸ Change the cutting disc.
	The centering bushing is fitted incorrectly.	▸ Check that the mounting bore of the cutting disc to be fitted corresponds with the centering collar of the cutting disc mounting flange.
The saw doesn't start or is difficult to start.	The fuel tank is empty (no fuel in the carburetor).	▸ Fill the fuel tank. → page 8
	Air filter clogged with dirt or dust.	▸ Change the air filter.
	~~DSH 700~~ ~~DSH 900~~ The engine is flooded (spark plug wet).	▸ Remove the spark plug, dry the plug and allow the cylinder to dry out. ▸ Disengage the choke lever and repeat the starting procedure several times.
	~~DSH 700-X~~ ~~DSH 900-X~~ The engine is flooded (spark plug wet).	▸ Remove the spark plug, dry the plug and allow the cylinder to dry out.
	Wrong fuel mixture.	▸ Empty the fuel tank and flush out the tank and fuel supply line. ▸ Fill the fuel tank with the correct fuel.
	Air in the fuel line (no fuel reaching the carburetor).	▸ Remove the air from the fuel line by operating the fuel pump several times.
	The fuel filter is dirty or blocked (no fuel or too little fuel reaching the carburetor).	▸ Clean the fuel tank and change the fuel filter.
	No ignition spark visible or spark is too weak (seen when spark plug is removed).	▸ Clean the spark plug to remove carbon deposits. ▸ Check the spark plug electrode gap and set it correctly. ▸ Change the spark plug. ▸ Check the ignition coil, cable, plug connections and switch and change the defective part if necessary.
	Engine compression is too low.	▸ Check the engine compression and, if necessary, replace worn parts (piston rings, piston, cylinder, etc.).
	The ambient temperature is too low.	▸ Allow the saw to warm up to room temperature and repeat the starting procedure.
	The spark arrestor or exhaust exit is clogged.	▸ Clean the spark arrestor or exhaust exit.
	The decompression valve is stiff to operate.	▸ Make sure that the valve operates freely.
Low engine power / poor cutting performance	Air filter clogged with dirt or dust.	▸ Change the air filter.

Trouble or fault	Possible cause	Action to be taken
Low engine power / poor cutting performance	No ignition spark visible or spark is too weak (seen when spark plug is removed).	▸ Clean the spark plug to remove carbon deposits. ▸ Check the spark plug electrode gap and set it correctly. ▸ Change the spark plug. ▸ Check the ignition coil, cable, plug connections and switch and change the defective part if necessary.
	Wrong fuel mixture.	▸ Empty the fuel tank and flush out the tank and fuel supply line. ▸ Fill the fuel tank with the correct fuel.
	The disc specification is unsuitable for the material to be cut.	▸ Change the cutting disc or ask **Hilti** Service for advice.
	Drive belt or cutting disc slips.	▸ Check that the cutting disc is clamped securely. ▸ Have the product repaired by **Hilti** Service.
	Engine compression is too low.	▸ Check the engine compression and, if necessary, replace worn parts (piston rings, piston, cylinder, etc.).
	The product is used at an altitude greater than 1500 meters above sea level.	▸ Have the carburetor adjusted by **Hilti** Service.
	Incorrect carburetor setting (fuel / air mixture).	▸ Have the carburetor adjusted by **Hilti** Service.
Cutting disc rotates while the engine is idling.	Idling speed is too high.	▸ Check the idling speed and adjust it if necessary.
	The half-throttle position is engaged.	▸ Release the half-throttle position.
	Faulty centrifugal clutch.	▸ Change the centrifugal clutch.
Cutting disc doesn't rotate.	Inadequate drive belt tension or the drive belt is broken.	▸ Have the product repaired by **Hilti** Service.
Starter assembly doesn't work.	The clutch claws are not engaging.	▸ Clean the clutch claws so that they move freely.
	Starter cord is broken.	▸ Replace the starter cord.

10 Disposal

Most of the materials from which **Hilti** products are manufactured can be recycled. The materials must be correctly separated before they can be recycled. In many countries, your old tools, machines or appliances can be returned to **Hilti** for recycling. Ask **Hilti** Service or your Hilti representative for further information.

Drilling slurry

Disposal of drilling slurry directly into rivers, lakes or the sewerage system without suitable pretreatment presents environmental problems.

- Ask the local public authorities for information about current regulations.

We recommend the following pretreatment:

- Collect the drilling slurry (for example, using a wet-type vacuum cleaner).
- Allow the drilling slurry to settle and dispose of the solid material at a construction waste disposal site (addition of a flocculent may accelerate the settling process).
- The remaining water (alkaline, pH value greater than 7) must be neutralized by the addition of an acidic neutralizing agent or diluted with a large volume of water before it is allowed to flow into the sewerage system.

11 Manufacturer’s warranty

- Please contact your local **Hilti** representative if you have questions about the warranty conditions.

11.1 Federal emission control warranty statement

Your warranty rights and obligations

The U.S. Environmental Protection Agency (EPA), the California Air Resources Board (CARB), and **Hilti** are pleased to explain the Emission Control System Warranty applicable to your small non-road engine. In U.S. and Canada, small non-road engines must be designed, built and equipped to meet the stringent federal antismog standards. The equipment engine must be free from defects in materials and workmanship which cause it to fail to conform with U.S. EPA standards for the first two years from the date of sale to the ultimate purchaser. **Hilti** must warrant the emission control system on your small non-road engine for the periods of time listed above, provided there has been no abuse, neglect or improper maintenance of your unit. Your emission control system includes parts such as the carburetor and the ignition system. Where a warrantable condition exists, **Hilti** will repair at no cost to you. Expenses covered under warranty include diagnosis, parts and labor.

Manufacturer’s warranty coverage

All 2001 and later small non-road engines are warranted to meet the applicable EPA and CARB requirements for two years. If any emission related part on your engine (as listed above) is defective, the part will be repaired or replaced by **Hilti**.

Owner’s warranty responsibilities

As a small non-road engine owner, you are responsible for performance of the required maintenance as defined by **Hilti** in the owner’s manual. **Hilti** recommends that you retain all receipts covering maintenance on your small non-road engine, but **Hilti** cannot deny warranty solely for the lack of receipts or for your failure to ensure the performance of all scheduled maintenance. Any replacement part or service that is equivalent in performance and durability may be used in non-warranty maintenance or repairs, and shall not reduce the warranty obligations of the engine manufacturer. As the small non-road equipment owner, you should be aware, however, that **Hilti** may deny you warranty coverage if your small non-road engine or a part of it has failed due to abuse, neglect, improper maintenance, unapproved modifications or the use of parts not made or approved by the original equipment manufacturer. You are responsible for presenting your small non-road engine to **Hilti** as soon as the problem exists. The warranty repairs should be completed in a reasonable amount of time, not to exceed 30 days.

Coverage

Hilti warrants to the ultimate purchaser and each subsequent purchaser that your small non-road equipment engine will be designed, built equipped, at the time of sale, to meet all applicable regulations. **Hilti** also warrants to the initial purchaser and each subsequent purchaser that the emission-related warranted parts are free from defects in material and workmanship which cause the engine to fail to conform with applicable regulations for a period of two years. These warranty periods will begin on the date small non-road equipment engine is purchased by the initial purchaser. If any emission-related part on your engine is defective during this warranty period, the part will be replaced by **Hilti** at no cost to the owner. **Hilti** shall remedy warranty defects at authorized **Hilti** service and repair centers. Any authorized work done at an authorized **Hilti** service and repair center shall be free of charge to the owner if it is determined that a warranted part is defective. Any manufacturer-approved or equivalent replacement part may be used for any warranty maintenance or repairs on emission-related parts, and must be provided free of charge to the owner if the part is still under warranty. **Hilti** is liable for damages to other engine components caused by the failure of a warranted part still under warranty. The California Air Resources Board’s Emission Warranty Part List specifically defines the emission related, warranted parts. These warranted parts are: the carburetor assembly, coil assembly, rotor, spark plug, air filter, fuel filter, breather manifold and the gaskets.

Maintenance requirements

The owner is responsible for performing the required maintenance as defined by **Hilti** in the owner’s manual.

Limitations

The Emission Control Systems Warranty shall not cover any of the following: a) repair or replacement required because of misuse, neglect or lack of required maintenance, b) repairs improperly performed or replacements not conforming to **Hilti** specifications that adversely affect performance and/or durability, and alterations or modifications not recommended or approved in writing by **Hilti**, and c) replacement of parts and other services and adjustments necessary for required maintenance at and after this first scheduled replacement point. Except as set forth above, the warranty terms set forth in section 12 below, apply.

11.2 Manufacturer's warranty

Hilti warrants that it will repair or replace any part containing a defect in material and workmanship for 20 years from the original sale date. This warranty is valid so long as the tool is operated and handled correctly, cleaned and serviced properly and in accordance with the **Hilti** Operating Instructions, and the technical system is maintained. This means that only original **Hilti** consumables, components and spare parts may be used in the tool.

This warranty provides the free-of-charge repair or replacement of defective parts only over the entire lifespan of the tool. Parts requiring repair or replacement as a result of normal wear and tear are not covered by this warranty.

Additional claims are excluded, unless stringent national rules prohibit such exclusion. In particular, Hilti is not obligated for direct, indirect, incidental or consequential damages, losses or expenses in connection with, or by reason of, the use of, or inability to use the tool for any purpose. Implied warranties of merchantability or fitness for a particular purpose are specifically excluded.

For repair or replacement, contact **Hilti** immediately upon discovery of the defect at:

In the USA:

800.879.8000

Hilti Inc.

7250 Dallas Parkway, Suite 1000

Plano, TX 75024

CS.InboundUS@hilti.com

In Canada:

800.343.4458

Hilti (Canada) Corporation

2360 Meadowpine Blvd

Mississauga, ON L5N 6S2

CanadaSalesSupport.English@hilti.com

CanadaSalesSupport.French@hilti.com

This constitutes **Hilti**'s entire obligation with regard to warranty and supersedes all prior or contemporaneous comments and oral or written agreements concerning warranties.

Hilti Corporation
LI-9494 Schaan
Tel.: +423 / 234 21 11
Fax: +423 / 234 29 65
www.hilti.com

Pos. 3 | 20160408

2122989

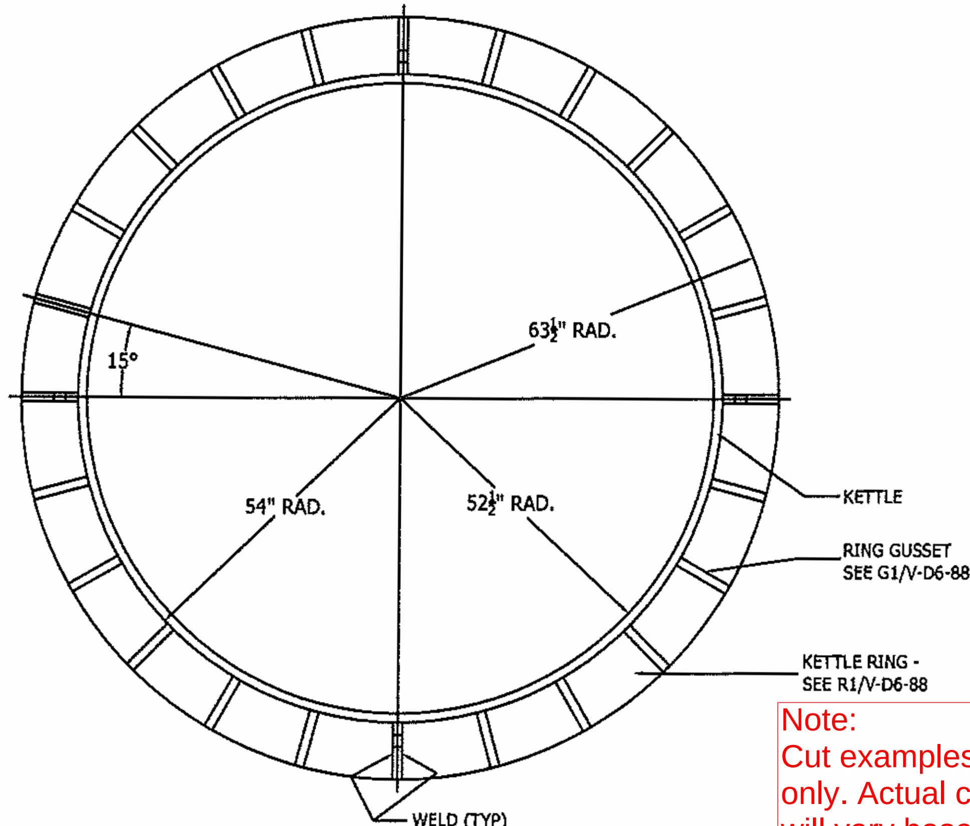
Attachment G

Kettle Cut Sketch

P.O. Box 92316, Long Beach, CA 90809-2316 • 1502 E. Opp St., Wilmington, CA 90744-3927
Phone: 310.522.1168 • 888.423.6060 • Fax 310-522-0474
www.americanintegrated.com • Contractors License #757133

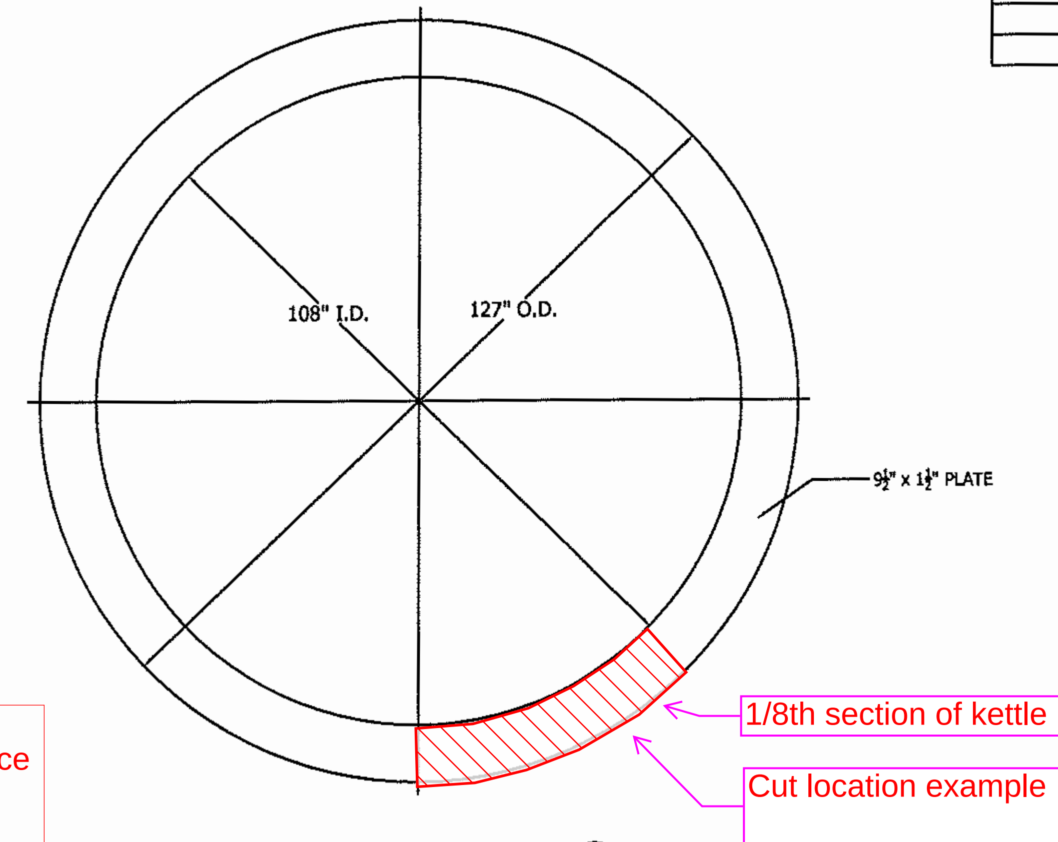
REVISIONS

REV. NO.	DATE	REVISION
1	9/30/2009	GUSSET TOTAL CHANGED FROM 28 TO 24



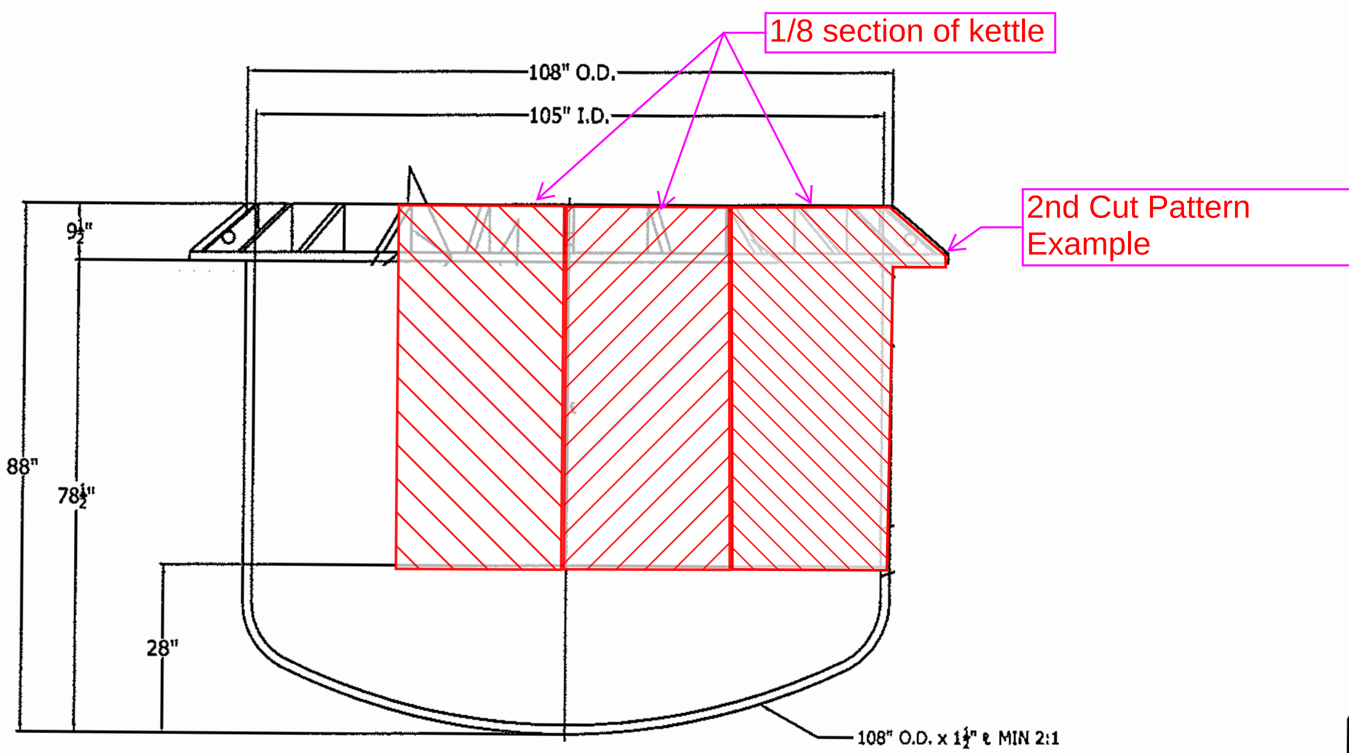
PLAN V2 V-D6-88

Note:
Cut examples are for visual reference only. Actual cut locations and sizes will vary based on field conditions.

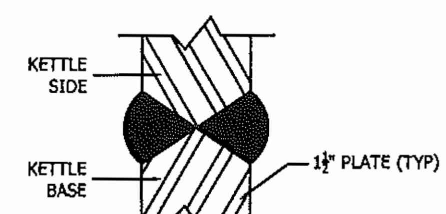


KETTLE RING R1 V-D6-88

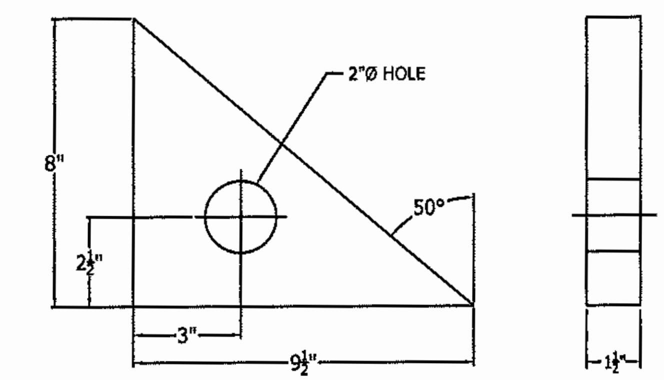
NOTES
(1) ALL STEEL IS TO BE ASTM A-516-70
(2) ALL SEAM WELDS TO BE 100% CHAMFERED WITH COMPLETE PENETRATION.
(3) ALL STEEL PLATE TO BE 1½" THICK
(4) ALL WELDS SHALL BE X-RAY TESTED.



ELEVATION V1 V-D6-88



TYPICAL KETTLE SEAM WELD W1 V-D6-88
NOT TO SCALE



TYPICAL RING GUSSET G1 V-D6-88
NOT TO SCALE

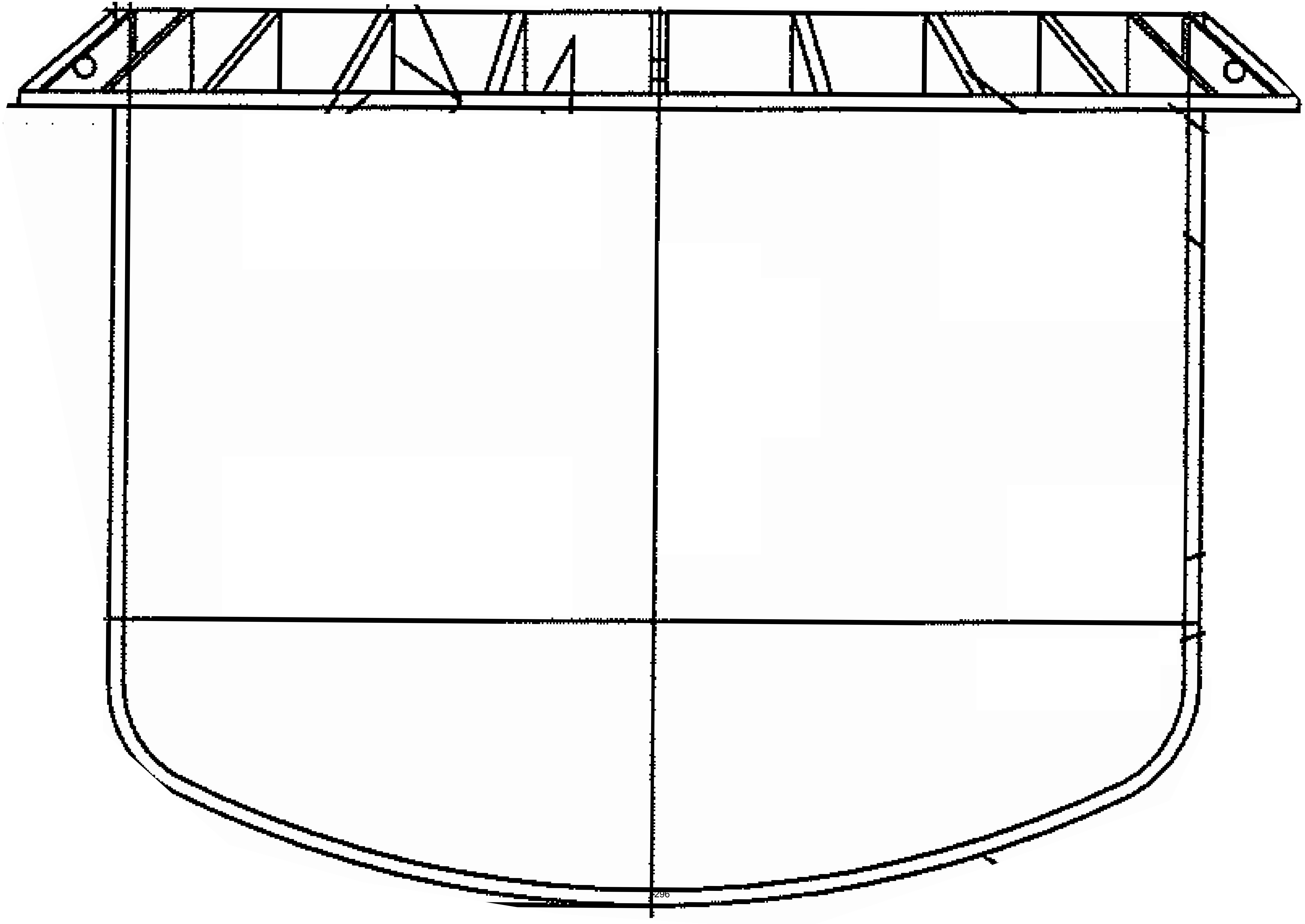
(20) PLATES REQUIRED WITHOUT HOLE
(4) PLATES REQUIRED WITH HOLE, 90° APART

DO NOT SCALE - WORK TO DIMENSIONS
295 ALLOWABLE VARIATIONS ON DIMENSIONS ARE: TWO-PLACE DECIMALS ±0.010 THREE-PLACE DECIMALS ±0.005 FRACTIONS ±1/64

EXIDE CORPORATION VERNON, CA.
METALS DIVISION

VERNON - 100 TON KETTLE

DRAWN TLM	DATE 1/16/2009	SCALE ⅜" = 1' - 0"	
CHECKED	DRAWING NO. V-D6-88		REV. 1
APPROVED			



Attachment H

Typical Breaker Attachment

P.O. Box 92316, Long Beach, CA 90809-2316 • 1502 E. Opp St., Wilmington, CA 90744-3927
Phone: 310.522.1168 • 888.423.6060 • Fax 310-522-0474
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search...

-- BXR Series Hydraulic Breakers

BXR Series Hydraulic Breakers

OVERVIEW | BROCHURE | SIZING | PRODUCTION RATES | TOOLS | ROCK HARDNESS

BTI's BXR Series Breakers offer outstanding power to weight ratio, and exceptional efficiency with the oil regeneration system. Overall system designed for harsh, continuous duty for use in demanding rock breaking applications.

- Two speed hydraulic pilot power control; controls blow energy in varying material conditions.
- Oil regeneration system; increases bpm's without decreasing energy in harder material applications.
- High volume nitrogen charged accumulator; provides constant blow energy and recoil absorption.
- Extra-long stroke pressure balanced piston in conjunction with oil regeneration system; optimizes impact energy and bpm's.
- Button nose piston design; maximizes energy transfer to the tool.
- Anti-blank fire interlock; protects front head and retainer pins.

TECHNICAL SPECIFICATIONS

		BXR50	BXR65	BXR85	BXR100	BXR120	BXR160
Energy Class	ft-lbs Joules	5,000 6,800	6,500 8,800	8,500 11,500	10,000 13,500	12,000 16,300	16,000 21,500
Operating Weight (including top bracket)	lbs kg	4,200 1,900	4,860 2,200	6,500 2,950	7,800 3,550	9,050 4,100	12,400 5,630

TECHNICAL SPECIFICATIONS								
Overall Length (including standard bracket)	in mm	103 2,622	112 2,863	127 3,241	133 3,399	137 3,502	155 3,943	
Oil Flow Range	gpm lpm	40-53 150-200	42-56 158-210	46-61 173-230	62-82 233-310	79-106 300-400	89-119 338-450	
Working Pressure Range	psi bar	2,250-2755 155-190	2,250-2755 155-190	2,250-2755 155-190	2,250-2755 155-190	2,250-2755 155-190	2,250-2755 155-190	
Blow Rate Long Stroke* Short Stroke*	bpm bpm	387-589 445-804	335-514 385-684	285-435 328-578	317-482 365-636	308-474 354-592	238-366 274-475	
Tool Diameter	in mm	5.5 140	6.0 150	6.3 160	6.7 170	7.1 180	7.9 200	
Exposed Tool Length	in mm	25.1 635	26.2 665	29.0 745	30.0 770	31.0 810	36.5 930	
Recommended Carrier Weight	lb m tonne	39,700- 77,200 18-35	41,900- 92,600 19-42	61,700- 105,800 28-48	75,000- 150,000 34-68	92,600- 178,600 42-81	121,300- 220,500 55-100	
Underwater provision hole		standard	standard	standard	standard	standard	standard	standard
Auto grease provision hole		standard	standard	standard	standard	standard	standard	standard
2-stroke remote control		standard	standard	standard	standard	standard	standard	standard
Oil regeneration system		standard	standard	standard	standard	standard	standard	standard
Anti-blank fire interlock		standard	standard	standard	standard	standard	standard	standard
Grease unit installed on breaker		optional	optional	optional	optional	optional	optional	optional
Grease unit installed on excavator		optional	optional	optional	optional	optional	optional	optional
Silenced box housing		standard	standard	standard	standard	standard	standard	standard
Severe duty wear kit		optional	optional	optional	optional	optional	optional	optional

* the maximum bpm includes the effects of the energy recovery system

OVERVIEW | BROCHURE | SIZING | PRODUCTION RATES | TOOLS | ROCK HARDNESS

BTI Mine Runner Milton Quarry Testimonial

Hydraulic Wheel Drive

Vibratory Pick Scaling

Rockbreaker Systems   Mobile Equipment   Hydraulic Breakers   Attachments   Dealers   Account Login

American Integrated Services, Inc.

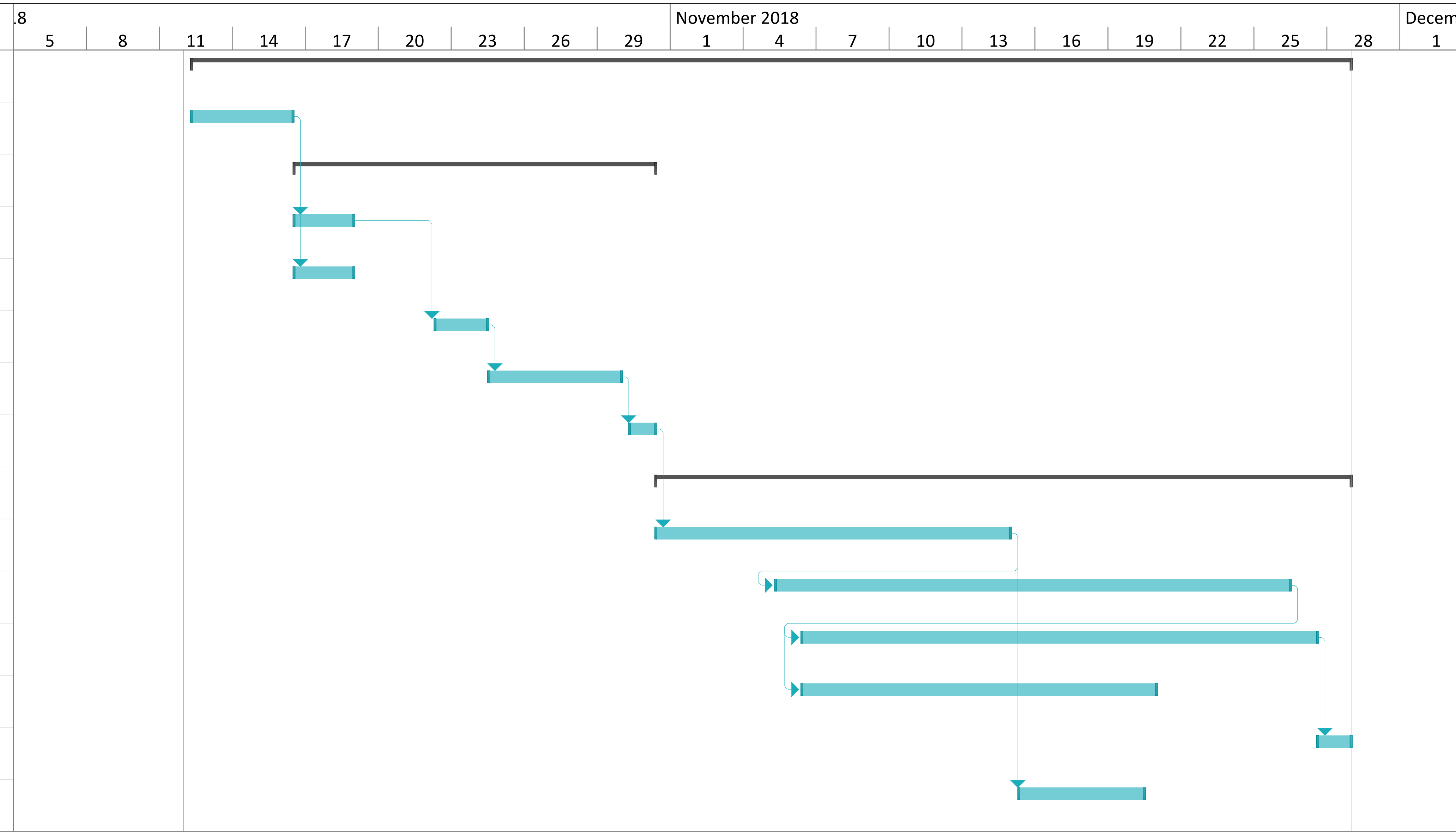
Attachment I

Schedule

P.O. Box 92316, Long Beach, CA 90809-2316 • 1502 E. Opp St., Wilmington, CA 90744-3927
Phone: 310.522.1168 • 888.423.6060 • Fax 310-522-0474
www.americanintegrated.com • Contractors License #757133

American Integrated Services, Inc.

ID	Task Mode	Task Name	Duration	Start	Finish
1		**Kettle Removal**	**21.6 days**	**Fri 10/12/18**	**Wed 11/28/18**
2		Mobilization	2 days	Fri 10/12/18	Tue 10/16/18
3		**Gantry Installation**	**7 days**	**Tue 10/16/18**	**Wed 10/31/18**
4		Set Matting	2 days	Tue 10/16/18	Thu 10/18/18
5		Install Vertical Shoring- Two Basement Locations	2 days	Tue 10/16/18	Thu 10/18/18
6		Set Railing	2 days	Mon 10/22/18	Wed 10/24/18
7		Set Gantry	2 days	Wed 10/24/18	Mon 10/29/18
8		Controller Installation & System Test	1 day	Tue 10/30/18	Wed 10/31/18
9		**Kettle Removal**	**13.4 days**	**Wed 10/31/18**	**Wed 11/28/18**
10		Kettle Picks	7 days	Wed 10/31/18	Wed 11/14/18
11		Remove Lead from Kettles	10 days	Mon 11/5/18	Mon 11/26/18
12		Load Lead & Prep for Trans	10 days	Tue 11/6/18	Tue 11/27/18
13		Kettle Decontamination	7 days	Tue 11/6/18	Tue 11/20/18
14		Remove Lead from Site	1 day	Tue 11/27/18	Wed 11/28/18
15		Gantry Demobilization	2 days	Thu 11/15/18	Tue 11/20/18



Project: msproj11
Date: Mon 12/5/16

Task		Project Summary		Inactive Milestone		Manual Summary Rollup		Deadline	
Split		External Tasks		Inactive Summary		Manual Summary		Progress	
Milestone		External Milestone		Manual Task		Start-only		Manual Progress	
Summary		Inactive Task		Duration-only		Finish-only			

APPENDIX 7

EXIDE SEPTEMBER 29, 2016 LETTER

EXIDE TECHNOLOGIES

Global Leader
in Stored Electrical Energy

Exide Technologies
2700 S. Indiana Street
Vernon, CA 90058
Phone 323.262.1101
Fax 323.269.1906

September 29, 2016

Suhasini Patel
Senior Environmental Scientist Supervisor
Department of Toxic Substances Control
Corrective Actions and Data Management
8800 Cal Center Drive
Sacramento, CA 95826-3200

Re: *Closure Plan, Alternative 3, Mechanical Kettle Removal – Gantry System Method; Exide Technologies, Vernon, California*

Dear Su:

You earlier advised me that DTSC is preliminarily considering adopting the Mechanical Removal Alternative 3 (Mechanical Removal Alternative) analyzed in the Closure Plan's DEIR to remove the hardened lead from the former kettles in Exide's Vernon Smelter Building. This option relates to the kettles which could not otherwise be removed by crane due to their weight. As you know, Exide has submitted extensive data and analysis to support its belief that re-melting lead in the kettles is the most feasible and safest removal method, as well as the best solution to protect worker safety and the environment. However, in light of DTSC's possible selection of the Mechanical Removal Alternative, Exide engaged Advanced GeoServices (AGC) to study whether there is another method by which that alternative could be implemented in a safer and more acceptable manner that would reduce the serious health and safety worker risks and also reduce environmental impacts. AGC recently reported back that an adjustment to the Mechanical Removal Alternative, whereby a gantry system would be used, would reduce the impacts assessed in the DEIR, particularly the serious worker health and safety impacts of which Exide is most concerned.

The "Gantry System Method" which Exide now proposes be used to implement the Mechanical Removal Alternative is detailed in the attached report by AGC. As explained in the report, a gantry system is a modular piece of construction equipment that uses a combination of a steel frame and a hydraulic system to lift very heavy objects, up to 500 tons. A structural engineer has confirmed that the existing walls and floor in the Smelter Building can support this gantry system. After decontaminating and deconstructing the Smelter Building and Blast Furnace Feed Room, Exide would use the gantry system to lift each kettle into the footprint of the deconstructed Blast Furnace Feed Room and cut the kettle and the lead before loading the pieces and shipping them offsite. This method reduces the significant concerns and impacts associated with the Mechanical Removal Alternative as presently defined. In particular:

- The Gantry System Method significantly reduces worker safety and exposure concerns because it eliminates the need for confined space entry into the kettles. Instead, workers would cut both the kettles, and the remaining lead, from outside the confined space of the kettle.

- The Gantry System Method is efficient and does not dramatically impact the Closure schedule. While not as quick to implement as re-melting, the Gantry System Method could be conducted with a 2-month delay, as opposed to the 8-month delay previously analyzed for the Mechanical Removal Alternative.

- Air emissions would actually be lower than those already analyzed as part of the Mechanical Removal Alternative. All work would still be conducted under a negative pressure enclosure and, because the Gantry System Method can be implemented under a much shorter timeframe, it reduces the impacts analyzed as part of Mechanical Removal Alternative.

- Similar cutting equipment would be used, and therefore noise impacts during implementation would be comparable to those already studied in the DEIR. And, because the Gantry System Method is quicker, aggregate noise impacts will actually be reduced.

- Traffic impacts will be lessened, also because the implementation time frame is shorter.

In sum, if DTSC decides not to adopt Exide's proposed and preferred re-melting method for removal of the lead in kettles, Exide respectfully asks that DTSC consider adopting the Gantry System Method which is specifically tailored to reduce the serious adverse health and safety worker risks as well as other environmental impacts of the Mechanical Removal Alternative. Importantly, as the Gantry System approach is only a very slight variation in implementation methodology for the Mechanical Removal Alternative already fully analyzed in the DEIR, with no new (only lesser) environmental, health and safety impacts, we believe that DTSC's approval of this approach will also allow us to maintain the present EIR certification and Closure Plan approval schedule, proceeding with Vernon's closure without further delay.

We look forward to discussing this issue more with you after your review of the enclosed AGC study. Thank you in advance for your consideration.

Very truly yours,

J Hogarth

John Hogarth
Exide Vernon – Plant Manager

cc: Wayne Lorentzen (DTSC)
Peter Ruttan (DTSC)

MECHANICAL KETTLE REMOVAL – GANTRY SYSTEM METHOD
EXIDE TECHNOLOGIES
VERNON, CALIFORNIA

Prepared For:

EXIDE TECHNOLOGIES
Vernon, California

Prepared By:

ADVANCED GEOSERVICES
West Chester, Pennsylvania

Project No. 2013-2993
September 26, 2016

MECHANICAL KETTLE REMOVAL – GANTRY SYSTEM METHOD
EXIDE TECHNOLOGIES
VERNON, CALIFORNIA

Prepared For:

EXIDE TECHNOLOGIES
Vernon, California

Prepared By:

ADVANCED GEOSERVICES
West Chester, Pennsylvania

Project No. 2013-2993
September 26, 2016

REGISTERED PROFESSIONAL ENGINEER JENNIFER WALNOCK DIJOSEPH NO. C86096 Exp. 9/30/18 CIVIL STATE OF CALIFORNIA

9/26/16

Jennifer W. DiJoseph, P.E.
Project Consultant
California P.E. No. C86096

9/26

Paul G. Stratman, P.E.
Consultant
California P.E. No. C61595

NO. C61595 EXP. 6/30/17 CIVIL

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PAGE NO.

LIST OF ATTACHMENTS

ATTACHMENT

1.0 INTRODUCTION AND BACKGROUND

1.1 INTRODUCTION

Exide Technologies (Exide) understands that the Department of Toxic Substances Control (DTSC) is preliminarily considering adopting Alternative 3 (Mechanical Removal) from the December 2015 Draft Environmental Impact Report (DEIR) for kettle removal. Exide previously concluded that the Alternative 3 method was infeasible due to unacceptable worker hazards and schedule impacts. In the eventuality that DTSC does adopt its Alternative 3, Exide requested that Advanced GeoServices Corp. (Advanced GeoServices) study whether the Mechanical Removal Alternative 3 could be implemented in a more acceptable manner that materially reduces its serious adverse worker safety effects and other environmental, health and safety impacts. Exide and Advanced GeoServices worked with several engineers and technical consultants to develop a gantry lifting system, and associated kettle dismantling process, that could deconstruct the kettles consistent with the terms of the Closure Plan. As a result, Advanced GeoServices has determined that by use of a gantry system to remove the kettles (Gantry System Method), Alternative 3 can be modified to reduce its earlier determined adverse worker safety effects while also reducing environmental impacts. If DTSC integrates the Gantry System Method, Mechanical Removal Alternative 3 could then be deemed feasible. The Gantry System Method described in this study presents DTSC with an environmentally conscious, and worker sensitive, option for mechanical removal of the kettles and their contents.

1.2 BACKGROUND

The Closure Plan and the DEIR identify three alternatives for removal of seven kettles containing hardened lead that are too heavy to be removed with the existing Smelter Building cranes. The seven kettles are summarized as follows:

- Unit 90 (Receiving Kettle B) (50 tons)
- Unit 91 (Receiving Kettle E) (65 tons)
- Unit 92 (Receiving Kettle F) (100 tons)

- Unit 93 (Receiving Kettle G) (12 tons)
- Unit 96 (Refining Kettle 3) (15 tons)
- Unit 97 (Refining Kettle 4) (30 tons)
- Unit 100 (Refining Kettle 7) (15 tons)

The hardened lead removal methods previously presented in the Closure Plan, DEIR and other correspondence are summarized as follows:

Table 1 – Removal Method Summary

Method	Reference Document	Exide's Evaluation of Feasibility
Re-melting	DEIR Proposed Project	Preferred method; feasible
Mechanical Removal	DEIR Alternative 3; Exide March 25, 2016 Comments on DEIR	Not feasible
Water Jet Cutting	DEIR Alternative 4; Exide March 25, 2016 Comments on DEIR	Not feasible
Crane Removal	Exide July 29, 2016 letter	Not feasible

As discussed in the DEIR and Closure Plan, Alternative 3 (Mechanical Removal) would require the use of a backhoe and jackhammers, operated by workers both outside and inside a kettle, to cut pieces of lead out of the larger block within each kettle. The pieces would then be manually removed by workers from inside each kettle. Previous correspondence Exide provided to DTSC demonstrated why Alternative 3 was infeasible without modification. The Gantry System Method proposed herein resolves several of the issues that previously led to an infeasibility determination.

In follow-up discussions with contractors, Exide has identified a methodology to vary the Mechanical Removal method originally analyzed as Alternative 3 in the DEIR, which Exide believes is feasible in terms of avoidance of hazards to workers, negligible environmental impact, acceptable minimal impact on schedule, and a reasonable increase of cost. This letter presents the Gantry System Method for mechanical removal of the kettles and an evaluation of the method for DTSC's consideration.

2.0 PROPOSED GANTRY SYSTEM METHOD

2.1 GANTRY SYSTEM METHOD TASKS

The Gantry System Method generally includes using a specialized gantry system to lift the seven kettles, transfer them to the Blast Furnace Feed Room footprint, and, using conventional construction equipment, subsequently cut the removed kettles and hardened lead into smaller pieces for transport to a secondary lead smelter for recycling. A preliminary layout is provided in Attachment A. The tasks anticipated for the Gantry System Method, and their relationship with closure activities, are as follows:

1. Install Full Enclosure at Segment 2 (Smelter Building and Blast Furnace Feed Room) to provide a filtered negative pressure ventilation enclosure to contain Segment 2. This is a required closure task which will be conducted regardless of the kettle removal method used.

2. Decontaminate and remove former Interim Status units and equipment within the Smelter Building and Blast Furnace Feed Room. This is a required closure task which will be conducted regardless of the kettle removal method used. This includes:

    a. Removal of the six kettles which can be lifted with the existing Smelter Building cranes; and,
    b. Vacuuming loose material from the seven kettles which cannot be lifted with the existing Smelter Building cranes.

3. Decontaminate and deconstruct the Smelter Building and Blast Furnace Feed Room, including roof sheeting, wall sheeting, structural steel and concrete walls to the grade of the floor slab. This is a required closure task which will be conducted regardless of the kettle removal method use.

4. At this point, the Full Enclosure Segment 2 would contain only the seven kettles (still sitting in their housings in the kettle gallery basement area) which cannot be lifted with the existing Smelter Building cranes and a concrete floor slab at the Smelter Building and Blast Furnace Feed Room footprints that has been vacuumed and washed to reduce the potential for tracking or dust generation.

5. Install a gantry system with hydraulic lifting mechanism along both sides of the kettle area and extending into the Blast Furnace Feed Room footprint.

6. Lift each kettle by its existing lifting rings with the gantry system and move the kettle and gantry system along the rails to the Blast Furnace Feed Room footprint.

7. Place the lifted kettle on the existing concrete slab at the Blast Furnace Feed Room.

8. Cut the steel kettle with saws, and remove the steel pieces from the hardened lead. Hot torches would not be used to cut the steel kettle.

9. Cut the hardened lead into smaller pieces using an excavator with hammer attachment or similar.

10. Load kettle and lead pieces onto transport vehicles located within the Segment 2 enclosure.

11. Prepare the vehicles for transport per Closure Plan Appendix G requirements. This is a required closure task which will be conducted regardless of the kettle removal method used.

12. Ship kettle and lead pieces off-site per the Closure Plan. This is a required closure task which will be conducted regardless of the kettle removal method used.

13. Decontaminate and remove kettle housings associated with the seven kettles. This is a required closure task which will be conducted regardless of the kettle removal method used.

14. Decontaminate floor slab in Smelter Building footprint and Blast Furnace Feed Room footprint in the area used for kettle removal and cutting.

15. Remove the Full Enclosure Segment 2. This is a required closure task which will be conducted regardless of the kettle removal method used.

16. Construct Full Enclosure Segment 3. This is a required closure task which will be conducted regardless of the kettle removal method used.

In addition, Advanced GeoServices and Exide evaluated an alternative sequencing that placed the installation of the gantry system before decontamination and deconstruction of the former Interim Status units, equipment, and the Smelter Building itself. However, the presence of structural building elements, the furnaces, and other equipment would constrain the operational space and would prevent the use of a gantry system and thus the alternative sequencing was infeasible.

2.2 GANTRY SYSTEM

A gantry system is a modular piece of construction equipment used to lift heavy items and is commonly used in similar industrial situations. The proposed gantry system has a lifting capacity of up to 500 tons, which exceeds the 107 tons of the heaviest kettle (100 tons of hardened lead, 7 tons of empty kettle). The proposed system includes a steel frame which rolls along rails on the ground surface. The frame spans across the item being lifted, and a hydraulic lifting mechanism is used to lift the item. The frame with the lifted item is then rolled along the rails to its destination. A typical gantry system design is provided in Attachment B.

To confirm the feasibility of the Gantry System Method, a structural engineer has conducted an initial evaluation of the proposed gantry system in relation to the existing Smelter Building and

Blast Furnace Feed Room floor and walls, including basement walls, and concluded that the floors and walls could structurally support the system. If the Gantry System Method is implemented, then a detailed engineering evaluation will be completed and minor modifications to the placement of the gantry system may be needed, but it would continue to be located on the existing floor and within Full Enclosure Segment 2.

2.3 KETTLE LIFTING RING EVALUATION

A structural engineer has conducted an initial evaluation and concluded that the existing lifting eyes on the kettles can be used in their current condition or with minimal modifications. A lifting sling would not be required.

2.4 KETTLE AND LEAD CUTTING

A kettle containing lead will be placed on the existing floor of the Blast Furnace Feed Room by the gantry system. Construction saws will be used to cut the steel kettle surrounding the lead. Cutting of steel kettles with construction saws is a common practice for industrial facilities. The pieces of steel would be pulled away from the hardened lead. The kettle would be cut away from the mass of lead before lead cutting would occur because construction saws are not capable of effectively cutting the lead .

The process of cutting the kettle with construction saws is similar to cutting and sizing of other scrap metal generated during implementation of the Closure Plan. Deconstruction of the kettles and other metal structures is a required closure task that will be conducted regardless of the kettle removal method used.

After the kettle is cut and removed from the lead mass, the lead would remain on the existing floor. An excavator with a jackhammer-like attachment would be used to cut the lead into smaller pieces to allow for transport. Cutting of lead with a jackhammer-like attachment on an excavator is a common practice for industrial facilities.

Cutting of the kettle and lead during the Gantry System Method will occur indoors in the Segment 2 Full Enclosure, which is similar to the conditions analyzed in Alternative 3 in the DEIR occurring within the Smelter Building.

3.0 IMPACTS

3.1 SAFETY

As noted in Exide's March 28, 2016 comments on the DEIR and other correspondence with DTSC, safety of personnel is a significant concern for Alternative 3 (Mechanical Removal) since personnel would be located within the kettle to manually conduct the lead cutting. In contrast, the Gantry System Method has substantially fewer safety impacts than Alternative 3 because personnel would not enter the kettle to cut up the hardened lead. As noted above, the kettle would be cut away from the lead mass first and thereby reduce safety impacts and increase lead cutting efficiency.

The confined space entry required by the methods previously described in Alternative 3 would not be required for Gantry System Method, and the precautions necessary to regulate entry would not be necessary. Confined space entry is an inherently dangerous activity that OSHA procedures and California guidance recommend avoiding if at all possible as noted in Exide's March 28, 2016 comments on the DEIR. A document from the California Department of Industrial Relations titled "*Is It Safe to Enter a Confined Space? Confined Space Guide*" dated May 2012 states on page 17 that each employer should ask at the onset of each project: "Is confined space entry always necessary; or is it possible to complete the task from the outside?" and "If possible, *avoid entering the confined space.* Every consideration should be given to completing the task from the outside." In addition, OSHA procedures (Appendix A to 40 CFR 1910.146) and the aforementioned California guidance would direct the employer to stay out of the confined space if a means of performing the task without entering the space can be found. Implementation of Gantry System Method, as a variation of Alternative 3, would avoid use of confined space entry.

Personnel implementing the Gantry System Method would also not have the potential hazard of a sudden collapse of the kettle while a worker is inside because the worker would not be inside the kettle. In addition, the potential for physical injury caused by lifting and moving the lead pieces within the kettle is reduced as lifting and moving of lead pieces would be performed by construction equipment on the Blast Furnace Feed Room floor footprint.

Exide consulted with its Closure Contractor and determined that the Gantry System Method can be implemented safely. The Gantry System Method would use known construction methods (i.e., gantry system operations, steel cutting with saws, lead cutting with excavator attachments) that the Closure Contractor can implement based on substantial experience with similar methods. In addition, the Closure Contractor would perform job safety hazard analyses for the various steps of the method to identify and minimize potential safety hazards prior to the start of work.

Therefore, the safety of personnel using the Gantry System Method is substantially improved compared to Alternative 3 presented in the DEIR.

3.2 AIR EMISSIONS

The DEIR determined that Alternative 3, as proposed in the DEIR, would contribute minimal air emissions when considered in the context of the larger project. The emissions associated specifically with Alternative 3 were deemed unavoidable and consist primarily of the potential for mechanical cutting operations to generate airborne particles that could contain lead. These insignificant and unavoidable emissions would be captured by the existing emissions control devices as the activities will be conducted within a full negative pressure enclosure vented to those devices. As described below, implementation of Alternative 3 with the Gantry System Method would have a lower potential to generate these minimal emissions, primarily due to the ability to shorten the time duration of the activities by utilizing the Gantry System Method.

During implementation of the Gantry System Method, particulate matter would be captured by the existing emission control devices. This is the same condition as originally considered in Alternative 3. The Gantry System Method would be implemented within the Full Enclosure

Segment 2 that would operate under negative pressure as required by SCAQMD Rule 1420.1. The air within Full Enclosure Segment 2 would be managed by existing air emission control devices (i.e., baghouses), which are SCAQMD-approved and operated per the facility's Title V permit.

In addition, construction equipment capable of lifting heavier weights than personnel would be used to manage the lead pieces; therefore, the hardened lead could be cut into larger pieces using fewer cuts. As fewer cuts would be used, less particulate matter would be released into the air within the Full Enclosure during implementation of the Gantry System Method. In Alternative 3, the DEIR contemplated that the hardened lead would be cut by a jackhammer operated by a person, and the pieces of lead would need to be smaller to be manageable, which requires more cuts and more potential particulate matter emission generation. SCAQMD-approved air emission control equipment would be used to capture the lead particulate that is generated under either Alternate 3, or a minor variation of it, using the Gantry System Method.

Furthermore, the Gantry System Method would use construction equipment for a shorter duration than analyzed in Alternative 3, and therefore would have less associated air emissions and greenhouse gas emissions. The Gantry System Method would have a similar amount of emissions associated with vehicle trips for shipment of the kettle and lead pieces.

The Gantry System Method reduces the air emission impacts of Alternative 3 presented in the DEIR.

3.3 NOISE IMPACTS

As noted in the DEIR regarding Alternative 3, lead cutting would generate less noise and vibration than other construction equipment used during the Closure Plan and would not be a primary source of noise. Moreover, the noise generated during Gantry System Method by the excavator's attachment cutting the lead into pieces would be comparable to, and has no greater noise impacts than, the conventional jackhammer method used in Alternative 3.

The saws used to cut the kettle away from the lead mass have similar noise characteristics as the excavators, shears, and other construction equipment that would be used to deconstruct structures and equipment at the facility under any scenario. The duration of the Gantry System Method is shorter than the methods previously analyzed in Alternative 3; and therefore less noise would be generated.

The Gantry System Method reduces the noise impacts of Alternative 3 presented in the DEIR.

3.4 TRAFFIC IMPACTS

The Gantry System Method would have less overall construction worker vehicle trips because the duration of work is shorter than the methods previously described in Alternative 3. The quantity of trips for shipment of kettle and lead pieces would be the same for the Gantry System Method and Alternative 3.

Approximately 6 to 8 truck trips would be required to deliver the gantry system, and an additional 6 to 8 truck trips would be required to demobilize the equipment. While the quantity of truck trips for equipment delivery and demobilization of the gantry system is slightly greater than that for Alternative 3, the quantity of total trips is similar to Alternative 3 because the overall number of construction vehicle trips for the proposed Project would be reduced.

The Gantry System Method reduces the traffic impacts of Alternative 3 presented in the DEIR.

3.5 SCHEDULE IMPACT

The total duration of the Gantry System Method would be approximately 12 weeks, which includes:

- 6 weeks – gantry system design and delivery;
- 2 weeks - gantry system installation;

- 2 weeks - move the seven kettles to the Blast Furnace Feed Room footprint and begin cutting the kettles and hardened lead and loading the materials for shipment; and,
- 2 weeks – complete cutting the kettles and hardened lead and loading the materials for shipment.

Gantry system design and delivery would occur concurrent with other activities within the Smelter Building or Blast Furnace Feed Room. Gantry system installation, kettle movement and cutting would occur after deconstruction of the Smelter Building and Blast Furnace Feed Room and would not adversely impact other activities occurring within the Smelter Building or Blast Furnace Feed Room as those activities would have already been completed.

Using the sequence of activities shown in the compressed schedule (16 hours per day, 5 days per week) provided in the November 2015 draft of the Closure Plan, the 12-week duration for mechanical removal by the Gantry System Method would cause an approximately 2 month delay in subsequent closure activities, as shown on the adjusted schedule in Attachment C. The critical-path impact on the closure schedule would be delay in moving the Full Enclosure from Segment 2 to Segment 3; however, other closure activities such as decontamination within the Baghouse Building and closure activities outside of the North Yard buildings could continue concurrently with the Gantry System Method activities.

As noted in Exide's March 28, 2016 comments on the DEIR, Alternative 3 would require 300 8-hour shifts to implement, or approximately 30 weeks using the compressed schedule of two 8-hour shifts, 5 days per week that was used to evaluate the Project's environmental impacts in the DEIR, plus an additional 7 to 7.5 months to prepare and mobilize, for a total duration of 14 months minimum. No other activities could occur in the Smelter Building during implementation of Alternative 3 in order to protect worker safety and avoid conflicts between contractors within the tight work area of the Smelter Building. The 14-month duration for kettle lead removal under Alternative 3 would cause a minimum 8-month delay in implementation of furnace decontamination and removal and all subsequent activities related to the Smelter Building.

In contrast, the schedule delay caused by using the Gantry System Method (approximately 2 months) is substantially less than the schedule delay previously analyzed in Alternative 3 (8 months minimum).

4.0 COMPARISON OF METHODS

Advanced GeoServcies' September 17, 2015 Kettle Inventory Removal Comparison evaluated the three kettle removal methods available at that time for eleven factors (equipment used; rate of lead heel removal; time of removal; three separate employee risk factors consisting of personnel having to enter the confined space of the kettle; the potential for injury while moving lead pieces and potential for elevated blood lead levels in workers; kettle stability; water management; air emissions; temperature and experience with the method) by assigning a score of 1 to 5, with 5 being the best and 1 being the worst. The scores for each factor were then totalled to yield an overall comparison.

The comparison was revised to include the Gantry System Method and is provided in Attachment D. The comparison shows that the Gantry System Method has a score of 49 out of 55, which is greatly superior to the score of 23 for both Alternative 3 (Mechanical Removal) and Alternative 4 (Water Cutting). The re-melting process proposed as the Project in the DEIR had a score of 52 out of 55 and remains Exide's preferred process if DTSC does not incorporate the Gantry System Method into Alternative 3 before approval.

Alternative 3 had the lowest possible score (i.e., a score of 1) for five factors, including all of the three employee risk factors for confined space entry into the kettles, potential for physical injury while moving lead pieces and the potential of elevated blood lead levels, as well as the factors of kettle stability and experience with the method. The Gantry System Method has better scores for the three employee risk factors, kettle stability, and experience. The Gantry System Method is a superior method to accomplish Alternative 3 with less health and safety impacts and less environmental impacts than previously analyzed in the DEIR.

5.0 CONCLUSION

For all of the aforementioned reasons, the Gantry System Method is a feasible and superior method of implementing Alternative 3 for removal of the seven kettles. The Gantry System Method is the type of method, and minor variation in processes, contemplated by the terms of the Closure Plan. The specialized gantry system design, reduced schedule impacts, increased worker safety, and manageable sequencing of events during the Closure Plan implementation distinguish the Gantry System Method from previous assessments of Alternative 3. Integration of the Gantry System Method into Alternative 3 is a minor variation that does not introduce significant new impacts. In fact, the Gantry System Method substantially reduces the worker health and safety concerns, and other environmental impacts, associated with the version of Alternative 3 analyzed in the DEIR.

While Exide believes that re-melting of the lead in the kettles continues to be the most feasible and safest kettle removal method, we ask DTSC to consider the Gantry System Method in the event that the re-melting option is not selected by DTSC. Exide is available by phone or for an in-person meeting with DTSC at the facility to discuss the Gantry System Method further.

ATTACHMENT A

Gantry System Layout

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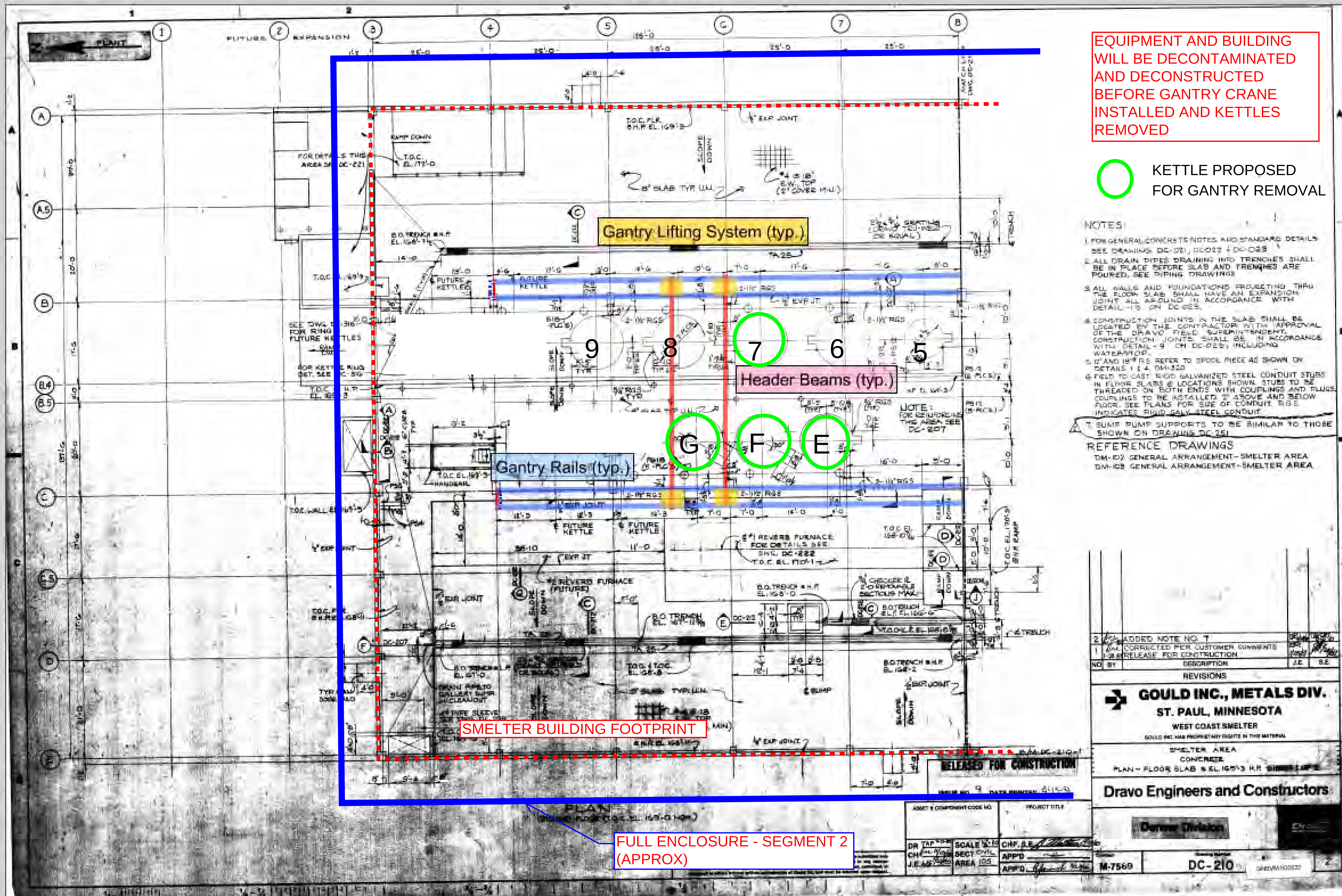

Measurement Type : Imperial

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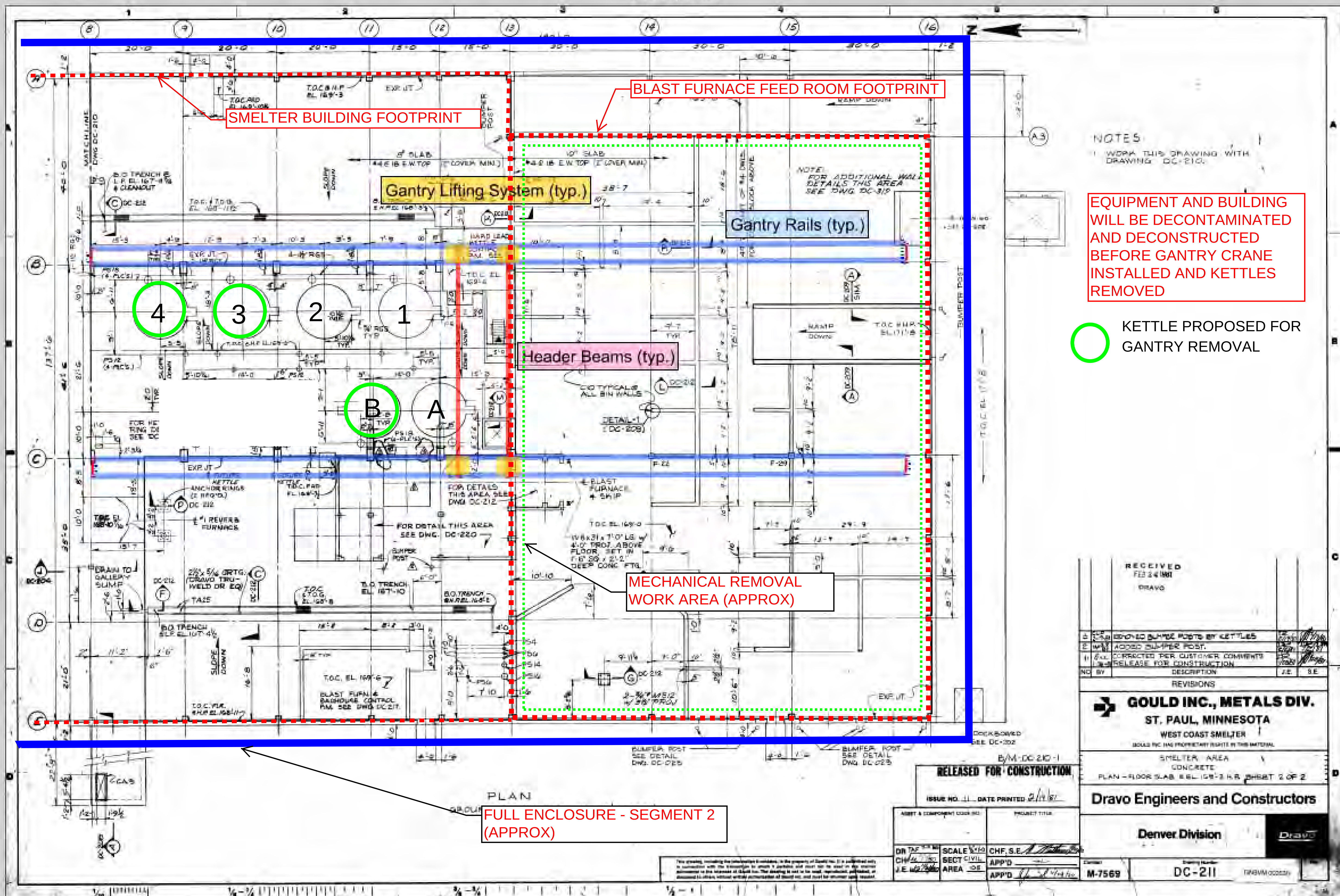

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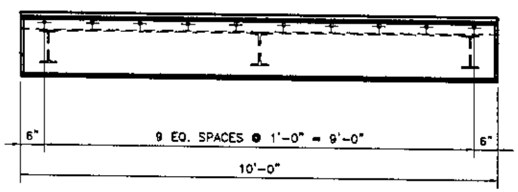
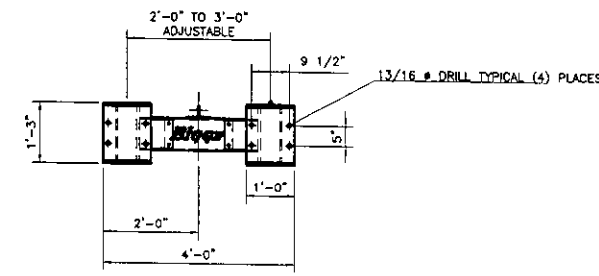
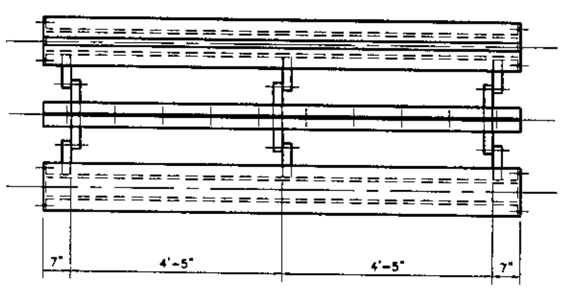
Measurement Type : Imperial

ATTACHMENT B

Typical Gantry System







SECTION PROPERTIES:

$S_x = 149$ in^2

$I_x = 1120$ in^2

WEIGHT = 2792 lbs

HYDRAULIC GANTRY RAIL – EQUIPMENT No. HGR-1A THRU HGR-1F

MANUFACTURED BY LIFT SYSTEMS (6 TOTAL)

APPROXIMATE WEIGHT = 2,800± Lbs. EA. NET

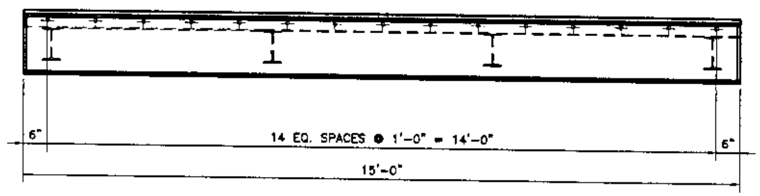
NO	REVISIONS	DATE	BY	DATE	BY	DATE	BY
0	PRELIMINARY DRAWING	1/13/03	CF				
		DRAWN		CHECKED		APPROVED	

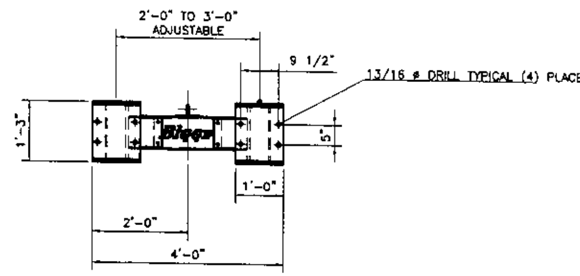
BIGGE Established 1916
CRANE and RIGGING CO.

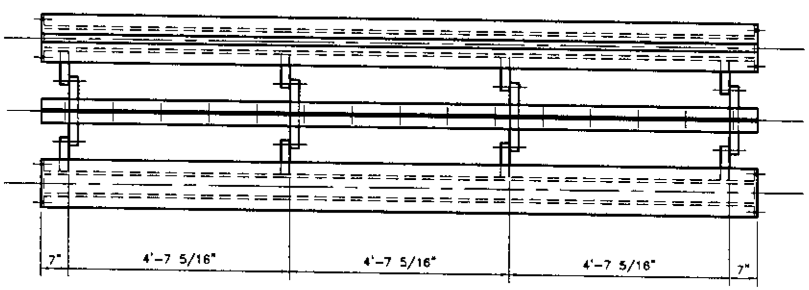
HYDRAULIC GANTRY RAIL
BIGGE EQUIPMENT NO.
HGR-1A THRU HGR-1F

SCALE	ENGR. No.	DWG. No.	SHEET	REV.
3/4" =1'-0"		HGR-1	1 of 1	0

JOB NO







SECTION PROPERTIES:
S_x = 149 in^2
I_x = 1120 in^2
WEIGHT = 4,200 lbs

HYDRAULIC GANTRY RAIL – EQUIPMENT No. HGR–2A THRU HGR–2D

MANUFACTURED BY LIFT SYSTEMS (4 TOTAL)

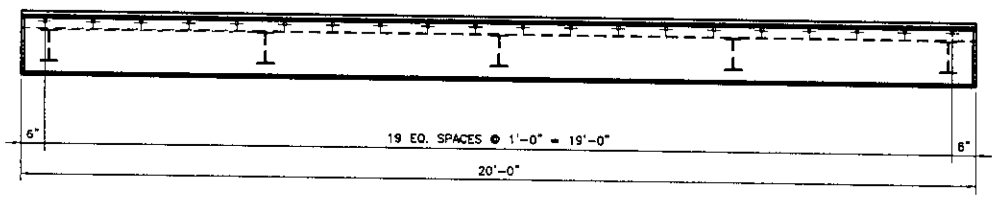
APPROXIMATE WEIGHT = 4,200± Lbs. EA. NET

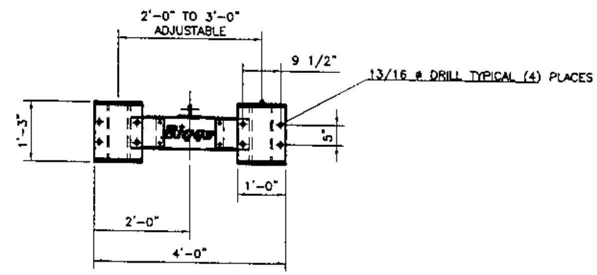
NO.	REVISIONS	DATE	BY	DATE	BY	DATE	BY
0	PRELIMINARY DRAWING	1/13/03	CF				
		DRAWN		CHECKED		APPROVED	

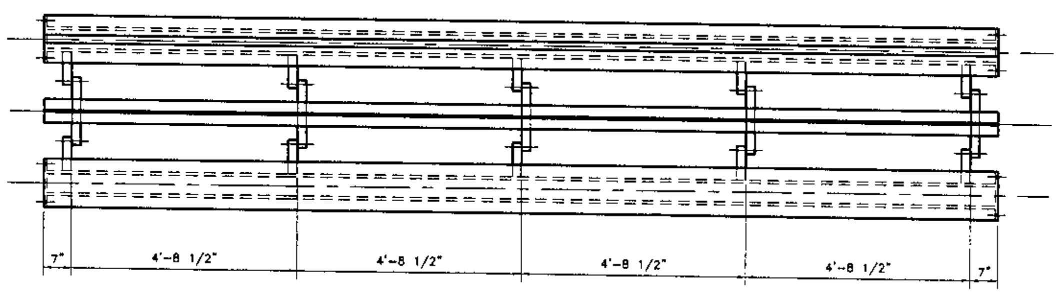
BIGGE Established 1916
CRANE and RIGGING CO.

HYDRAULIC GANTRY RAIL
BIGGE EQUIPMENT NO.
HGR–2A THRU HGR–2D

SCALE 3/4" =1'-0"	ENGR. No.	DWG. No. HGR–2	SHEET 1 of 1	REV. 0
JOB NO.				







SECTION PROPERTIES:
S_x = 149 in^2
I_x = 1120 in^2
WEIGHT = 5,600 lbs

HYDRAULIC GANTRY RAIL – EQUIPMENT No. HGR-3A THRU HGR-3K

MANUFACTURED BY LIFT SYSTEMS (16 TOTAL)

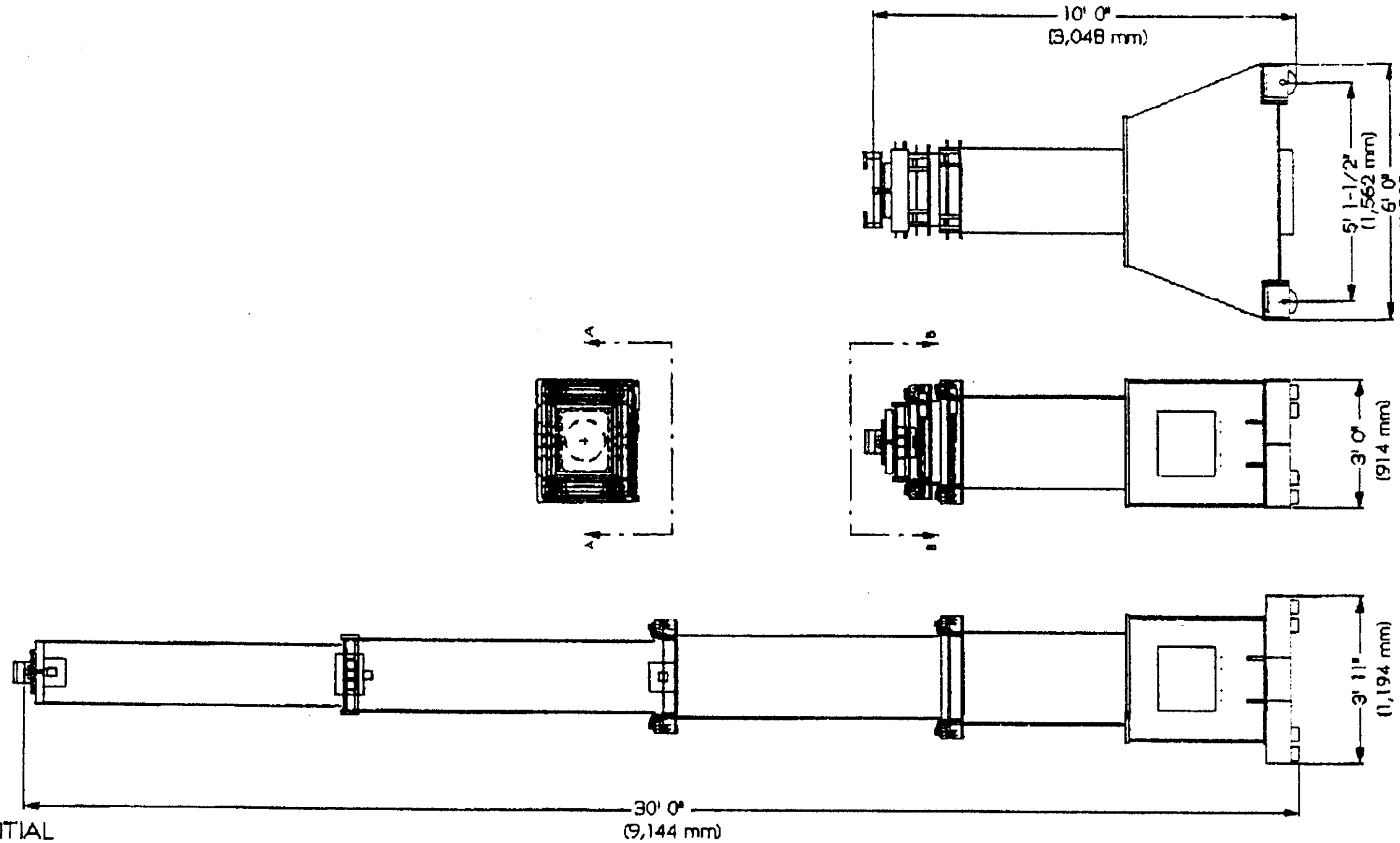
APPROXIMATE WEIGHT = 5,600± Lbs. EA. NET

0	PRELIMINARY DRAWING	1/13/03	CF				
NO.	REVISIONS	DATE	BY	DATE	BY	DATE	BY
		DRAWN		CHECKED		APPROVED	

BIGGE CRANE and RIGGING CO. Established 1916

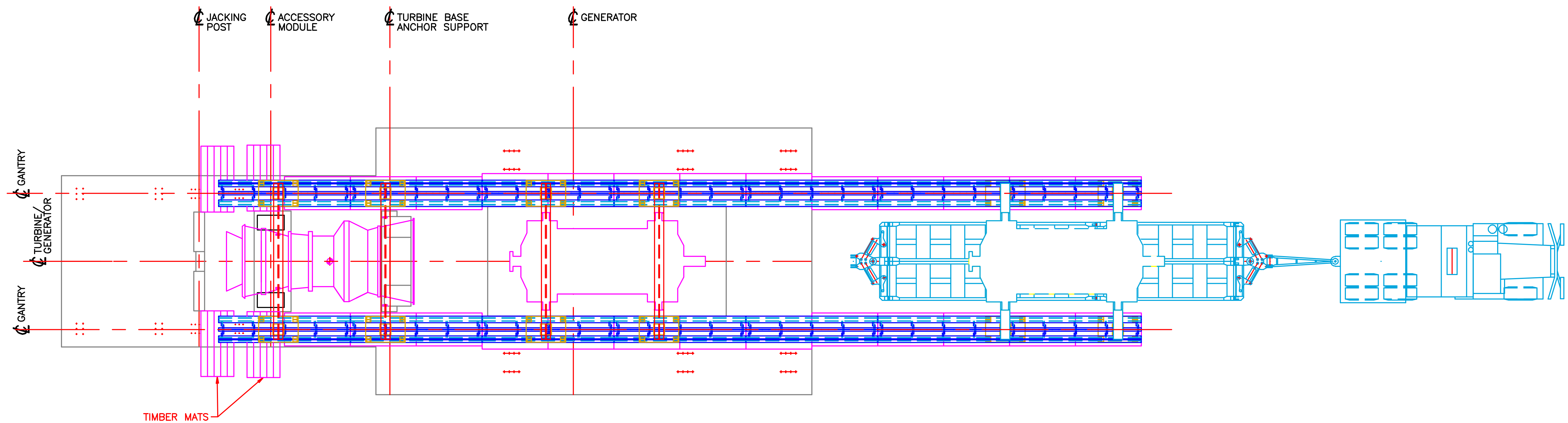
HYDRAULIC GANTRY RAIL
BIGGE EQUIPMENT NO.
HGR-3A THRU HGR-3K

SCALE	ENGR. No.	DWG. No.	SHEET	REV.
3/4" =1'-0"		HGR-3	1 of 1	0

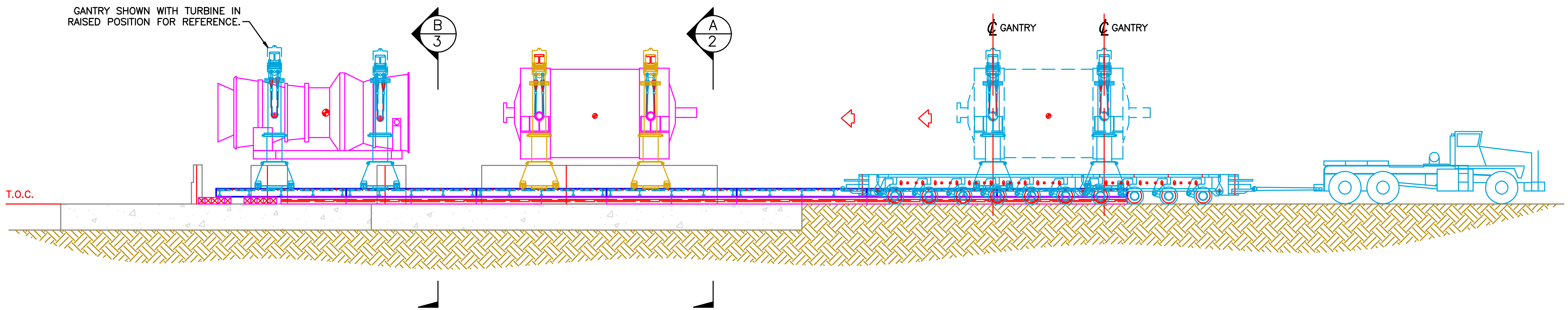


LIFT SYSTEMS
P.O. BOX 906 205 41ST STREET
MOLINE, ILLINOIS 61265

DRAWN BY: CRP	DATE: 12/5/97
MODEL 34PT5400WS	
DRAWING NUMBER	PTS279



COMBUSTION TURBINE — PLAN VIEW



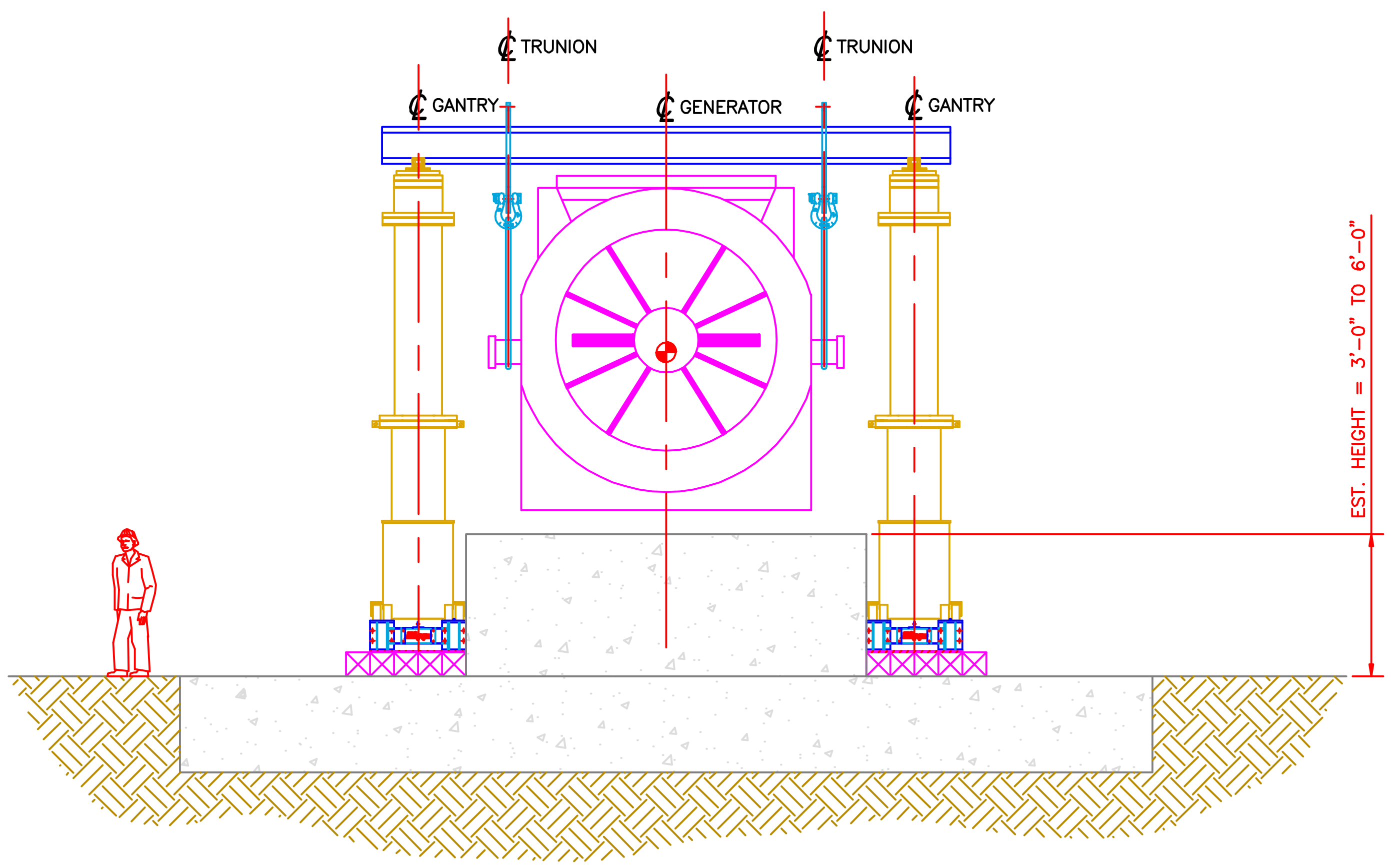
COMBUSTION TURBINE / GENERATOR — ELEVATION VIEW

BIGGE CRANE AND RIGGING CO.
BID DRAWING
FOR INFORMATION ONLY

NO.	REVISIONS	DATE	BY	DATE	BY	DATE	BY
A	PRELIMINARY	6/20/08	JTC				
		DRAWN		CHECKED		APPROVED	

BIGGE Established 1916
CRANE and RIGGING CO.

SCALE	ENGR. No.	DWG. No.	SHEET	REV.
1/8" =1'-0"		P3	1 of 2	A
JOB NO.				



SECTION A/1

BIGGE CRANE AND RIGGING CO.
BID DRAWING
FOR INFORMATION ONLY

A	PRELIMINARY	6/20/08	JTC				
		DATE	BY	DATE	BY	DATE	BY
NO.	REVISIONS	DRAWN		CHECKED		APPROVED	

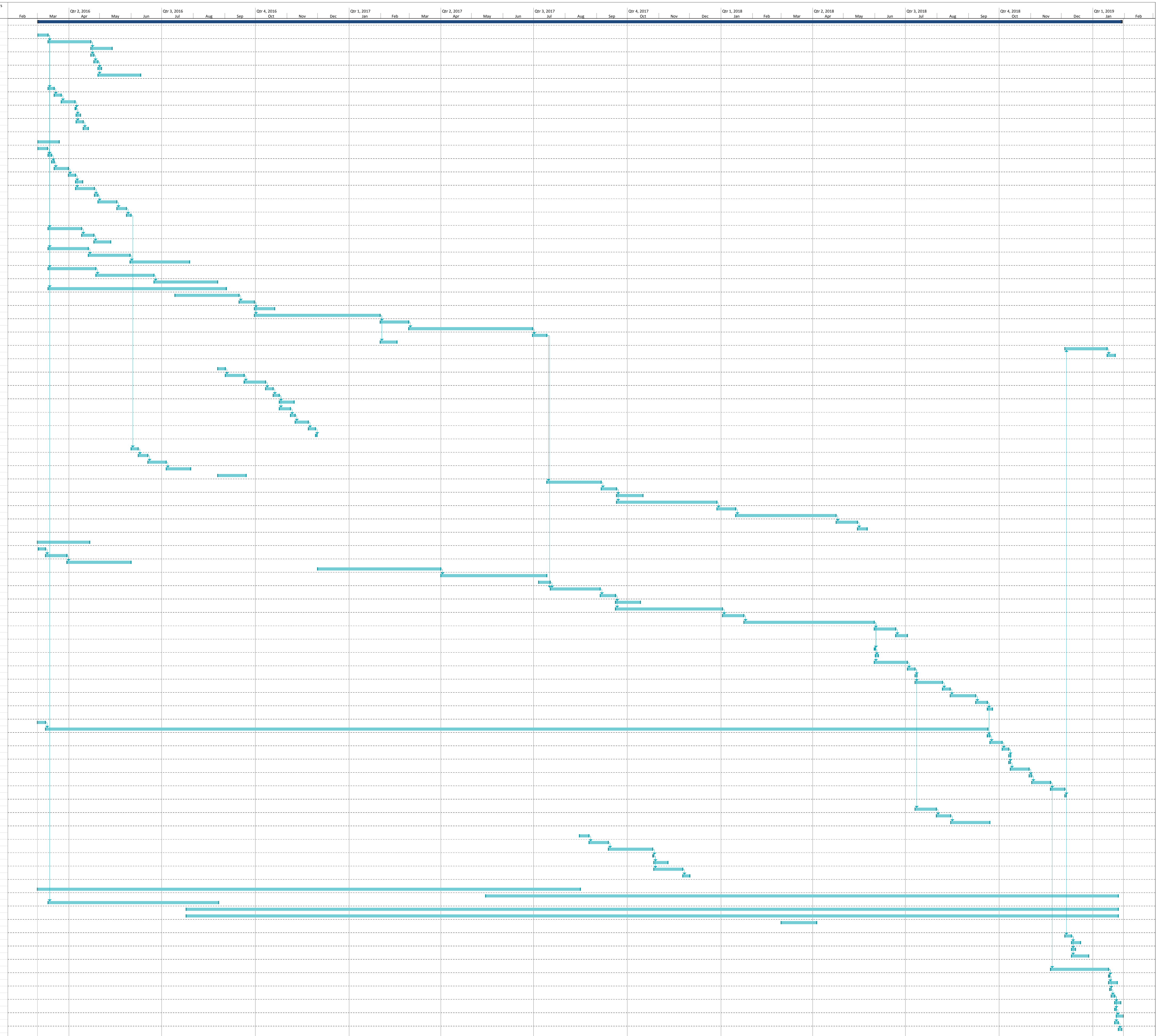
BIGGE CRANE and RIGGING CO. Established 1916

SCALE 1/8" =1'-0"	ENGR. No.	DWG. No. P3	SHEET 2 of 2	REV. A
JOB NO.				

ATTACHMENT C

Schedule Impacts

ID	Task Name	Duration	Start	Finish	Predecessors
1	CLOSURE PROJECT PHASE 1 - 16 hr/dy, 5 dy/wk	760.94 days	Tue 3/1/16	Tue 1/29/19	
2	**PROJECT PREP ITEMS**				
3	RMPS UNITS 44,79 MODIFICATIONS FOR OPERATION	8 days	Tue 3/1/16	Fri 3/11/16	
4	UNIT 1,2,3 CONTAINER STORAGE ENCLOSURE AND DECON	30 days	Fri 3/11/16	Fri 4/22/16	3
5	UNIT 1,2,3 SAMPLING	15 days	Fri 4/22/16	Fri 5/13/16	4
6	NEPTUNE SCRUBBER SUMP DECON AND REMOVAL	1 day	Fri 4/22/16	Mon 4/25/16	4
7	UNIT 35 MOBILE EQUIPMENT WASH DECON AND REMOVAL	4 days	Mon 4/25/16	Fri 4/29/16	6
8	UNIT 35 SAMPLING	1.5 days	Fri 4/29/16	Mon 5/2/16	7
9	SODA ASH SYSTEM DECON AND REMOVAL	30 days	Fri 4/29/16	Fri 6/10/16	7
10	**OXIDATION TANK AREA UNIT 24 AND 25**				
11	UNIT 24,25 OXIDATION TANK TEMP ENCLOSURE INSTALL	4 days	Fri 3/11/16	Thu 3/17/16	3
12	UNIT 24,25 OXIDATION TANK AND STRUCTURE DECON	5 days	Thu 3/17/16	Thu 3/24/16	11
13	UNIT 24,25 OXIDATION TANK AND STRUCTURE REMOVAL	9.5 days	Thu 3/24/16	Wed 4/6/16	12
14	UNIT 24,25 OXIDATION TANK CONTAINMENT AREA DECON	1 day	Wed 4/6/16	Thu 4/7/16	13
15	OXIDATION AREA SAMPLING	2.5 days	Thu 4/7/16	Tue 4/12/16	14
16	UNIT 24,25 OXIDATION TANK REMOVAL OF CONCRETE PEDESTAL	5 days	Thu 4/7/16	Thu 4/14/16	14
17	UNIT 24,25 OXIDATION TANK TEMP ENCLOSURE REMOVAL	3 days	Thu 4/14/16	Tue 4/19/16	16
18	**BLAST FEED BUILDING (UNIT 34) AND EQUIPMENT**				
19	BLAST FEED BUILDING PIPE RACK MODIFICATIONS	15 days	Tue 3/1/16	Tue 3/22/16	
20	MATERIAL BAGHOUSE PERMITTED DUCT MODIFICATIONS	7.5 days	Tue 3/1/16	Thu 3/10/16	
21	BLAST FEED BUILDING COKE EQUIPMENT DECON	1.5 days	Fri 3/11/16	Mon 3/14/16	20,3
22	BLAST FEED BUILDING COKE EQUIPMENT REMOVAL	2.5 days	Mon 3/14/16	Thu 3/17/16	21
23	BLAST FEED BUILDING TEMP ENCLOSURE INSTALL	10 days	Thu 3/17/16	Thu 3/31/16	22
24	BLAST FEED BUILDING DECON	5 days	Thu 3/31/16	Thu 4/7/16	23
25	BLAST FEED BUILDING SAMPLING	5 days	Thu 4/7/16	Thu 4/14/16	24
26	BLAST FEED BUILDING SIDING AND ROOFING REMOVAL	12.5 days	Thu 4/7/16	Mon 4/25/16	24
27	BLAST FEED BUILDING MODIFY ENCLOSURE TO WINDBREAK WALL	3.5 days	Mon 4/25/16	Fri 4/29/16	26
28	BLAST FEED BUILDING REMOVAL OF STRUCTURAL STEEL	12.5 days	Fri 4/29/16	Tue 5/17/16	27
29	BLAST FEED BUILDING REMOVAL OF CONCRETE WALLS	7.5 days	Tue 5/17/16	Fri 5/27/16	28
30	BLAST FEED BUILDING WINDBREAK WALL REMOVAL	2.5 days	Fri 5/27/16	Tue 5/31/16	29
31	**BAGHOUSE BUILDING AND EQUIPMENT**				
32	ROTARY DRYER UNIT 69 DECON AND REMOVAL	23 days	Fri 3/11/16	Wed 4/13/16	3
33	ROTARY DRYER BAGHOUSE DECON AND REMOVAL	8 days	Wed 4/13/16	Mon 4/25/16	32
34	BAGHOUSE BLDG EQUIPMENT DECON / REMOVAL (UNIT 31, 32)	12.5 days	Mon 4/25/16	Wed 5/11/16	33
35	REVERB BAGHOUSE DECON AND REMOVAL	27.5 days	Fri 3/11/16	Tue 4/19/16	3
36	WET SCRUBBER DECON AND REMOVAL	29 days	Tue 4/19/16	Mon 5/30/16	35
37	SOFT LEAD BAGHOUSE DECON AND REMOVAL	42.5 days	Mon 5/30/16	Thu 7/28/16	36
38	BLAST BAGHOUSE DECON AND REMOVAL	33 days	Fri 3/11/16	Wed 4/27/16	3
39	MATERIAL BAGHOUSE DECON AND REMOVAL	41 days	Wed 4/27/16	Thu 6/23/16	38
40	HARD LEAD BAGHOUSE DECON AND REMOVAL	44.5 days	Thu 6/23/16	Wed 8/24/16	39
41	STACKS DECON AND REMOVAL AS NEEDED	125 days	Fri 3/11/16	Fri 9/2/16	3
42	BAGHOUSE BUILDING TEMP ENCLOSURE INSTALL	45 days	Thu 7/14/16	Wed 9/14/16	
43	BAGHOUSE BUILDING DECON	11 days	Wed 9/14/16	Thu 9/29/16	42
44	BAGHOUSE BUILDING SAMPLING	14 days	Thu 9/29/16	Wed 10/19/16	43
45	BAGHOUSE BUILDING REMOVAL OF SIDING AND ROOFING	87.5 days	Thu 9/29/16	Tue 1/31/17	43
46	BAGHOUSE BUILDING MODIFY ENCLOSURE FOR WINDBREAK WALL	20 days	Tue 1/31/17	Tue 2/28/17	45
47	BAGHOUSE BUILDING REMOVAL OF STRUCTURAL STEEL	87.5 days	Tue 2/28/17	Thu 6/29/17	46
48	BAGHOUSE BUILDING REMOVE WINDBREAK WALL	10 days	Thu 6/29/17	Thu 7/13/17	47
49	MAC BAGHOUSE TEMP ENCLOSURE INSTALL	12.5 days	Tue 1/31/17	Thu 2/16/17	45
50	MAC BAGHOUSE DECON AND REMOVAL	29.5 days	Tue 12/4/18	Mon 1/14/19	116
51	MAC BAGHOUSE TEMP ENCLOSURE REMOVAL	6 days	Mon 1/14/19	Tue 1/22/19	50
52	**DESULFURIZATION BUILDING AND EQUIPMENT**				
53	DESULFURIZATION EQUIPMENT UNIT 9,10,67 DECON	5.5 days	Thu 8/25/16	Thu 9/1/16	
54	DESULFURIZATION EQUIPMENT UNIT 9,10,67 REMOVAL	12.5 days	Thu 9/1/16	Mon 9/19/16	53
55	DESULFURIZATION EQUIPMENT UNIT 7,8 DECON AND REMOVAL	15 days	Mon 9/19/16	Mon 10/10/16	54
56	DESULFURIZATION BUILDING TEMP ENCLOSURE INSTALL	5.5 days	Mon 10/10/16	Tue 10/18/16	55
57	DESULFURIZATION BUILDING DECON	4 days	Tue 10/18/16	Mon 10/24/16	56
58	DESULFURIZATION BUILDING SAMPLING	10.5 days	Mon 10/24/16	Mon 11/7/16	57
59	DESULFURIZATION BUILDING REMOVAL OF SIDING AND ROOFING	9 days	Mon 10/24/16	Fri 11/4/16	57
60	DESULFURIZATION BUILDING MODIFY ENCLOSURE TO WINDBREAK WALL	2.5 days	Fri 11/4/16	Tue 11/8/16	59
61	DESULFURIZATION BUILDING REMOVAL OF STRUCTURAL STEEL	9 days	Tue 11/8/16	Mon 11/21/16	60
62	DESULFURIZATION BUILDING REMOVAL OF CONCRETE WALLS	5 days	Mon 11/21/16	Mon 11/28/16	61
63	DESULFERIZATION BUILDING WINDBREAK WALL REMOVAL	1.5 days	Mon 11/28/16	Wed 11/30/16	62
64	**RMPS AND UPPER FEED BUILDING (UNIT 33) AND EQUIPMENT**				
65	MAPCO SCRUBBER DUCT MODIFICATIONS	5 days	Tue 5/31/16	Tue 6/7/16	30
66	RMPS AND UPPER FEED UNIT 12,13,14,40,41,42,43,45,66,68,70,80 DECON	7.5 days	Tue 6/7/16	Fri 6/17/16	65
67	RMPS AND UPPER FEED UNIT 12,13,14,40,41,42,43,45,66,68,70,80 REMOVAL	12 days	Fri 6/17/16	Tue 7/5/16	66
68	RMPS MAPCO SCRUBBER DECON AND REMOVAL	18 days	Tue 7/5/16	Fri 7/29/16	67
69	RMPS FILTER PRESS 44 AND TANK 79 DECON AND REMOVAL	20 days	Thu 8/25/16	Wed 9/21/16	
70	RMPS AND UPPER FEED BUILDING TEMP ENCLOSURE INSTALL	37.5 days	Thu 7/13/17	Tue 9/5/17	48
71	RMPS AND UPPER FEED BUILDING DECON	11 days	Tue 9/5/17	Wed 9/20/17	70
72	RMPS AND UPPER FEED SAMPLING	18 days	Wed 9/20/17	Mon 10/16/17	71
73	RMPS AND UPPER FEED BUILDING SIDING AND ROOFING REMOVAL	70.5 days	Wed 9/20/17	Wed 12/27/17	71
74	RMPS AND UPPER FEED BUILDING MODIFY ENCLOSURE TO WINDBREAK WALL	12.5 days	Wed 12/27/17	Mon 1/15/18	73
75	RMPS AND UPPER FEED BUILDING REMOVAL OF STRUCTURAL STEEL	70.5 days	Mon 1/15/18	Mon 4/23/18	74
76	RMPS AND UPPER FEED BUILDING REMOVAL OF CONCRETE WALLS	15 days	Mon 4/23/18	Mon 5/14/18	75
77	RMPS AND UPPER FEED BUILDING WINDBREAK WALL REMOVAL	7.5 days	Mon 5/14/18	Thu 5/24/18	76
78	**SMELTING BUILDING AND EQUIPMENT**				
79	KETTLE PIPING AND REMELT LEAD	37.5 days	Tue 3/1/16	Thu 4/21/16	
80	REFINING CASTING CONVEYOR EQUIPMENT DECON	5 days	Wed 3/2/16	Tue 3/8/16	
81	REFINING CASTING CONVEYOR EQUIPMENT REMOVAL	15 days	Tue 3/8/16	Tue 3/29/16	80
82	KETTLE 89 THRU 102 DECON AND REMOVAL	45 days	Tue 3/29/16	Tue 5/31/16	81
83	REVERB FURNACE (UNIT 36) DECON AND REMOVAL	87 days	Thu 12/1/16	Fri 3/31/17	
84	BLAST FURNACE (UNIT 37)DECON AND REMOVAL	74 days	Fri 3/31/17	Thu 7/13/17	83
85	TORIT BAGHOUSE - MODIFY INLET DUCT	7.5 days	Thu 7/6/17	Mon 7/17/17	
86	SMELTING BUILDING TEMP ENCLOSURE INSTALL	35 days	Mon 7/17/17	Mon 9/4/17	85,48
87	SMELTING BUILDING DECON	11 days	Mon 9/4/17	Tue 9/19/17	86
88	SMELTER BUILDING SAMPLING	18.5 days	Tue 9/19/17	Fri 10/13/17	87
89	SMELTING BUILDING SIDING AND ROOFING REMOVAL	75 days	Tue 9/19/17	Tue 1/2/18	87
90	SMELTING BUILDING MODIFY ENCLOSURE TO WINDBREAK WALL	15 days	Tue 1/2/18	Tue 1/23/18	89
91	SMELTING BUILDING STRUCTURAL STEEL REMOVAL	92 days	Tue 1/23/18	Thu 5/31/18	90
92	SMELTING BUILDING REMOVAL OF CONCRETE WALLS	15 days	Thu 5/31/18	Thu 6/21/18	91
93	SMELTING BUILDING WINDBREAK WALL REMOVAL	7.5 days	Thu 6/21/18	Mon 7/2/18	92
94	**LOWER FEED BUILDING (UNIT 33) AND EQUIPMENT**				
95	LOWER FEED BUILDING SUMP EQUIPMENT DECON	1 day	Thu 5/31/18	Fri 6/1/18	91
96	LOWER FEED BUILDING SUMP EQUIPMENT REMOVAL	1 day	Fri 6/1/18	Mon 6/4/18	95
97	LOWER FEED BUILDING TEMP ENCLOSURE INSTALL	22.5 days	Thu 5/31/18	Mon 7/2/18	91
98	LOWER FEED BUILDING BUILDING DECON	5.5 days	Mon 7/2/18	Tue 7/10/18	97
99	LOWER FEED BUILDING SAMPLING	2 days	Tue 7/10/18	Thu 7/12/18	98
100	LOWER FEED BUILDING REMOVAL OF SIDING AND ROOFING	19 days	Tue 7/10/18	Mon 8/6/18	98
101	LOWER FEED BUILDING MODIFY ENCLOSURE TO WINDBREAK WALL	5.5 days	Mon 8/6/18	Mon 8/13/18	100
102	LOWER FEED BUILDING REMOVAL OF STRUCTURAL STEEL	19 days	Mon 8/13/18	Fri 9/7/18	101
103	LOWER FEED BUILDING REMOVAL OF CONCRETE WALLS	7.5 days	Fri 9/7/18	Wed 9/19/18	102
104	LOWER FEED BUILDING WINDBREAK WALL REMOVAL	3 days	Wed 9/19/18	Mon 9/24/18	103
105	**CORRIDOR BUILDING (UNIT33) AND EQUIPMENT**				
106	CORRIDOR DECON MODIFICATIONS	6 days	Tue 3/1/16	Tue 3/8/16	
107	CORRIDOR BUILDING DECON AREA OPERATIONS	660.94 days	Tue 3/8/16	Wed 9/19/18	106
108	CORRIDOR BUILDING DECON EQUIPMENT AND UNIT 51	2.5 days	Wed 9/19/18	Fri 9/21/18	103
109	CORRIDOR BUILDING TEMP ENCLOSURE INSTALL	8 days	Fri 9/21/18	Wed 10/3/18	108
110	CORRIDOR BUILDING DECON	4.5 days	Wed 10/3/18	Wed 10/10/18	109
111	CORRIDOR BUILDING SAMPLING	2 days	Wed 10/10/18	Fri 10/12/18	110
112	CORRIDOR BUILDING EQUIPMENT REMOVAL UNIT 51 SUMP	1.5 days	Wed 10/10/18	Thu 10/11/18	110
113	CORRIDOR BUILDING REMOVAL OF SIDING AND ROOFING	12.5 days	Thu 10/11/18	Tue 10/30/18	112
114	CORRIDOR BUILDING MODIFY ENCLOSURE TO WINDBREAK WALL	2.5 days	Tue 10/30/18	Thu 11/1/18	113
115	CORRIDOR BUILDING REMOVAL OF STRUCTURAL STEEL	12.5 days	Thu 11/1/18	Tue 11/20/18	114
116	CORRIDOR BUILDING REMOVAL OF CONCRETE WALLS	10 days	Tue 11/20/18	Tue 12/4/18	115
117	CORRIDOR BUILDING WINDBREAK WALL REMOVAL	1.5 days	Tue 12/4/18	Wed 12/5/18	116
118	**FINSHED LEAD BUILDING**				
119	TORIT NORTH AND SOUTH BAGHOUSE DECON	15 days	Tue 7/10/18	Tue 7/31/18	98
120	FINSHED LEAD BUILDING DECON	10 days	Tue 7/31/18	Tue 8/14/18	119
121	FINISHED LEAD BUILDING SAMPLING	28.5 days	Tue 8/14/18	Fri 9/21/18	120
122	**WWTP CONCRETE STRUCTURE AND EQUIPMENT**				
123	WWTP ENCLOSURE INSTALL	7.5 days	Tue 8/15/17	Thu 8/24/17	
124	WWTP EQUIPMENT DECON UNIT 63,76,52,54,53,57-61,55,56,77,71-75	13 days	Thu 8/24/17	Tue 9/12/17	123
125	WWTP EQUIPMENT REMOVAL UNIT 63,76,52,54,53,57-61,55,56,77,71-75	31.5 days	Tue 9/12/17	Wed 10/25/17	124
126	WWTP CONCRETE AREA DECON UNIT 62	1 day	Wed 10/25/17	Thu 10/26/17	125
127	WWTP SAMPLING	10 days	Thu 10/26/17	Thu 11/9/17	126
128	WWTP CONCRETE PEDESTAL REMOVAL	20.5 days	Thu 10/26/17	Fri 11/24/17	126
129	WWTP ENCLOSURE REMOVAL	5 days	Fri 11/24/17	Fri 12/1/17	128
130	**WWTP OPERATIONS DURING PHASE 1**				
131	EXISTING WWTP OPERATIONS	380.94 days	Tue 3/1/16	Tue 8/15/17	
132	TEMP WWTP OPERATIONS	444.94 days	Mon 5/15/17	Fri 1/25/19	
133	EXISTING WWTP FILTER PRESS OPERATIONS UNIT 7,8,44,79	119.44 days	Fri 3/11/16	Thu 8/25/16	3
134	TEMP WWTP FILTER PRESS OPERATIONS	654.94 days	Mon 7/25/16	Fri 1/25/19	
135	TEMP WATER STORAGE FEATURE	654.94 days	Mon 7/25/16	Fri 1/25/19	
136	CAUSTIC SYSTEM DECON AND REMOVAL	25 days	Thu 3/1/18	Wed 4/4/18	
137	**SITE WIDE DECON**				
138	SITE WIDE DECON, UNIT 103 DECON	4.5 days	Tue 12/4/18	Mon 12/10/18	116
139	UNIT 103 SAMPLING	7 days	Mon 12/10/18	Wed 12/19/18	138
140	ANCILLARY SUMPS SAMPLING	4 days	Mon 12/10/18	Fri 12/14/18	138
141	NON RCRA BUILDING ROOF DECON	13 days	Mon 12/10/18	Thu 12/27/18	138
142	**STORM WATER SYSTEM**				
143	STORM WATER SYSTEM PIPING, UNIT 46 DECON	41 days	Tue 11/20/18	Wed 1/16/19	115
144	STORM WATER SYSTEM PIPING PRESURE TEST	1 day	Wed 1/16/19	Thu 1/17/19	143
145	STORMWATER PIPE, UNIT 46 SAMPLING	6.5 days	Wed 1/16/19	Thu 1/24/19	143
146	STORM WATER SYSTEM DROP OUT UNIT 47,48,49,50 DECON	1.5 days	Thu 1/17/19	Fri 1/18/19	144
147	STORM WATER SYSTEM DROP OUT UNIT 47,48,49,50 REMOVAL	1.5 days	Fri 1/18/19	Tue 1/22/19	146
148	DROP OUT AREA SAMPLING	4 days	Tue 1/22/19	Mon 1/28/19	147
149	STORM WATER SURFACE IMPOUNDMENT UNIT 78 DECON	1.5 days	Tue 1/22/19	Wed 1/23/19	147
150	STORMWATER SURFACE IMPOUNDMENT UNIT 78 SAMPLING	5 days	Wed 1/23/19	Wed 1/30/19	149
151	WEST YARD TRUCK WASH DECON	3.5 days	Tue 1/22/19	Fri 1/25/19	147
152	WEST YARD TRUCK WASH SAMPLING	1.5 days	Fri 1/25/19	Tue 1/29/19	151
153					
154					



Project: Exide Closure Estimated S
Date: Fri 7/24/15

Task | Split | Milestone | Summary | Project Summary | External Tasks | External Milestone | Inactive Task | Inactive Milestone | Inactive Summary | Manual Task | Duration-only | Manual Summary Rollup | Manual Summary | Start-only | Finish-only | Deadline | Progress | Manual Progress

ATTACHMENT D

Kettle Method Comparison

EVALUATION TOPIC	MANUAL DEMOLITION (ALT 3)		WATER CUTTING (ALT 4)		REMELTING (DEIR PROJECT)		GANTRY SYSTEM METHOD	
Description	Uses high pressure air to cut small pieces of lead from larger mass.	NA	Uses high pressure water to cut small pieces of lead from larger mass	NA	Uses existing natural gas burners to heat lead until molten. Lead is pumped into molds. Final 5 tons is removed with an overhead crane.	NA	Uses gantry crane to move kettle and lead to work area. Kettle and lead cut into pieces with contruction equipment.	NA
Equipment Used	Mobilize air demolition equipment or backhoe with spade shaped tool.	3	Design, build and mobilize water cutting equipment. Specialty equipment would need to be designed and built over several months. 150 gpm of water at 20,000 to 40,000 psi	1	Use existing natural gas burners, pumps and molds. Install temporary natural gas line to service kettles.	5	Conventional gantry crane system, construction saws, excavator with hammer attachment. Some lead time required.	4
Rate of Lead Heel Removal	800 hours to cut 100 tons lead	1	400 hours to cut 100 tons lead	3	50 hours per 100 ton kettle	5	50 - 80 hours per 100 ton kettle	4
Time to Remove 300 tons Lead Heels	300 8-hr shifts, or 63 5-day weeks	1	Several months to build equipment, plus 150 8-hr shifts, or 32 5-day weeks	3	Approximately two 5-day weeks	5	Approximately two 5-day weeks	5
Employee Risk	Personnel enter kettle (confined space entry)	1	Personnel enter kettle (confined space entry)	1	Personnel do not enter kettle	5	Personnel do not enter kettle	5
	Very high potential for injury while moving lead pieces.	1	Very high potential for injury while moving lead pieces.	1	Minimal risk to employees as using existing equipment and historically successful safety procedures	5	Minimal risk to employees as using conventional construction equipment	5
	Very high potential for elevated lead in workers blood.	1	Very high potential for elevated lead in workers blood.	1	Minimal risk to employees as using existing equipment and historically successful safety procedures	5	Minimal risk to employees as using conventional construction equipmen	5
Kettle Stability	Kettle may not remain structurally sound during cutting and could suddenly collapse into housing	1	Kettle may not remain structurally sound during cutting and could suddenly collapse into housing	1	Kettle is expected to remain structurally sound as using procedures similar to historic operations	5	Kettle is expected to remain structurally sound as cutting will occur on the floor slab. Lifting rings may require minimal modification.	4
Water Management	Collect and treat water used for dust control	3	Collect and treat 9,000 gallons per hour (72,000 gallons per day) of water containing lead grit particules resulting from cutting. Water collection and treatment system would need to be designed and mobilized.	1	Collect and treat water used for dust control, if any.	4	Collect and treat water used for dust control	4
Air Emissions	Low risk to public as managed by existing Baghouses and associated HEPA secondary filtration per existing AQMD Permit	5	Low risk to public as managed by existing Baghouses and associated HEPA secondary filtration per existing AQMD Permit	5	Low risk to public as managed by existing Baghouses and associated HEPA secondary filtration per existing AQMD Permit	5	Low risk to public as managed by existing Baghouses and associated HEPA secondary filtration per existing AQMD Permit	5
Temperature	Ambient	5	Ambient	5	900 degrees F achieved in 24 hours. This is a lower temperature than used during typical smelting operation.	3	Ambient	5
Experience with Method	None. Trial & Error. Never Done on this Scale.	1	None. Trial & Error; Never done before	1	Exide employees are experienced with this method and have implemented these procedures successfully during historic operations.	5	Gantry crane, constuction saw, excavator jackhammer have conducted similar activities, but not in the same type of project	3
Evaluation Results	Not Selected - high employee risk, slow removal rate, new method, high risk of kettle instability	23	Not Selected - high employee risk, equipment not available, high water production, slow removal rate, new method, high risk of kettle instability	23	**Selected - low employee risk, reasonable removal rate, existing equipment**	**52**	Selected - low employee risk, reasonable removal rate, conventional construction equipment	**49**

NOTES:
1. Score is based on a best case score of 5, worst case score of 1.
2. Highest total score is the selected case.
3. Total possible score is 55.